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DEPARTMENT OF THE ARMY FIELD MANUAL

ARMY RAIL TRANSPORT OPERATIONS

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 19 February 1969

ARMY BAIL TRANSPORT OPERATIONS

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*This manual supersedes FM 55-21, 11 September 1963, including all changes; FM 55-21-1 (Test), 29 March 1967; and FM 55-22, 14 November 1962.



CHAPTER 1

INTRODUCTION

1-1. Purpose and Scope

a. This manual provides a guide for commanders and staffs at all command and operating levels and contains information pertaining to the organization and operation of a transportation railway service in a theater of operations.

b. The doctrine presented herein is applicable without modification to general, limited, and cold war.

c. Readers and users of this manual are encouraged to submit comments or recommendations to improve its clarity or accuracy. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and permit complete evaluation. Comments should be forwarded direct to the Commanding Officer, U.S. Army Combat Developments Command Transportation Agency, Fort Eustis, Virginia 23604. Originators of proposed changes which would constitute a significant modification of proposed Army doctrine may send an information copy through command channels to the Commanding General, U.S. Army Combat Developments Command, Fort Belvoir, Virginia 22060, to facilitate review and followup.

d. This manual is in consonance with the following international standardization agreements, which are identified by type of agreement at the beginning of each appropriate chapter in the manual: STANAG 2805E, Annex B, Classification of Restrictions Affecting the Movement of Certain Military Equipment by Land on Continental Western Europe; STANAG 2113, Destruction of Military Technical Equipment; STANAG 2158, Identification of Military Trains.

1-2. Transportation Railway Service in a Theater of Operations

a. The railway service is the overall organization of railway units assigned or attached to the senior transportation organization—normally a transportation command, theater army support command (TASCOM). It is composed of railway supervisory, operating, and maintenance units as required to operate trains, to maintain rail lines of communication, and to perform organizational and direct support maintenance of locomotives and rolling stock. Transportation railway service supervisory units are so constituted that, depending upon the extent of the operation, any one of them may perform the staff and planning functions of, and serve as, the highest echelon of the military railway service in a theater. The highest echelon of the transportation railway service in the theater is responsible for the reconnaissance of captured and liberated rail lines as early as practicable. The actual reconnaissance normally is performed by selected personnel from the railway battalion, augmented by personnel from higher rail units and the engineer command as required. The reconnaissance should produce the information required for planning. The railway battalion commander assigned the mission of operating a given section of rail line performs the necessary reconnaissance. He then determines the operating capabilities of the line in terms of net tonnage that may be handled, considering the characteristics of the line and the equipment and facilities actually available. Railway service normally is an intersectional service and may operate throughout the theater. In the event that an electric railway line is used, an electric power transmission unit maintains and repairs transmission facilities. General support main-

tenance of locomotives and rolling stock is performed by the transportation diesel-electric locomotive repair company and the transportation railway car repair company, both of which are assigned to the supply and maintenance command.

b. The operation of military railways may be accomplished in three phases:

(1) *Phase I operation.* The phase I operation is conducted exclusively by military personnel. The phase I operation normally is employed during (1) the early stages of a military operation when the employment of civilian rail personnel is not practical and (2) in or near the combat zone of a theater where restrictions on the employment of civilians and the press of military necessity and security require that railway operations be conducted by railway troops under a unified command.

(2) *Phase II operation.* During this phase, railway lines are operated and maintained by military railway personnel augmented with local civilian railway personnel under direct military supervision.

(3) *Phase III operation.* To provide for the release of military railway personnel, phase III operation is instituted as soon as practical. Under this arrangement, local civilian railway personnel operate and maintain railway lines under the direction and supervision of the highest military railway echelon in the theater. When practical, this phase is instituted in the rear areas of a stable and secure communications zone.

c. Although these phases normally progress in sequence, this does not preclude the inauguration of a phase II or III operation without progression through the preceding phases; nor does it preclude a similar regression of phases to meet military demands. The ultimate aim is to reduce requirements for military personnel and units to operate the railways. Since the phase III operation fulfills this aim and provides for the most economical employment of military units and personnel, it is, when it meets the military requirement, the most desirable phase of operation; every effort is made to inaugurate this operational phase as quickly as possible. Civil affairs organizations provide co-

ordination between the Army and the host country personnel (FM 41-10).

d. A prime consideration in establishment of phase II and III operations is the availability of skilled local labor which may be provided through civil affairs organizations.

e. During stable operations, the rail net normally will be operated by host country personnel with a minimum number of U.S. military personnel for supervision (FM 31-23).

1-3. Organization of the Transportation Railway Service

a. The transportation railway service consists of the following command, supervisory, operating, and maintenance units, which are illustrated in figure 1-1 and discussed in chapter 2.

(1) *Supervisory and command.*

(a) Headquarters and headquarters company, transportation railway brigade.

(b) Headquarters and headquarters company, transportation railway group.

(c) Headquarters and headquarters company, transportation railway battalion.

(2) *Operating and maintenance.*

(a) Transportation railway engineering company.

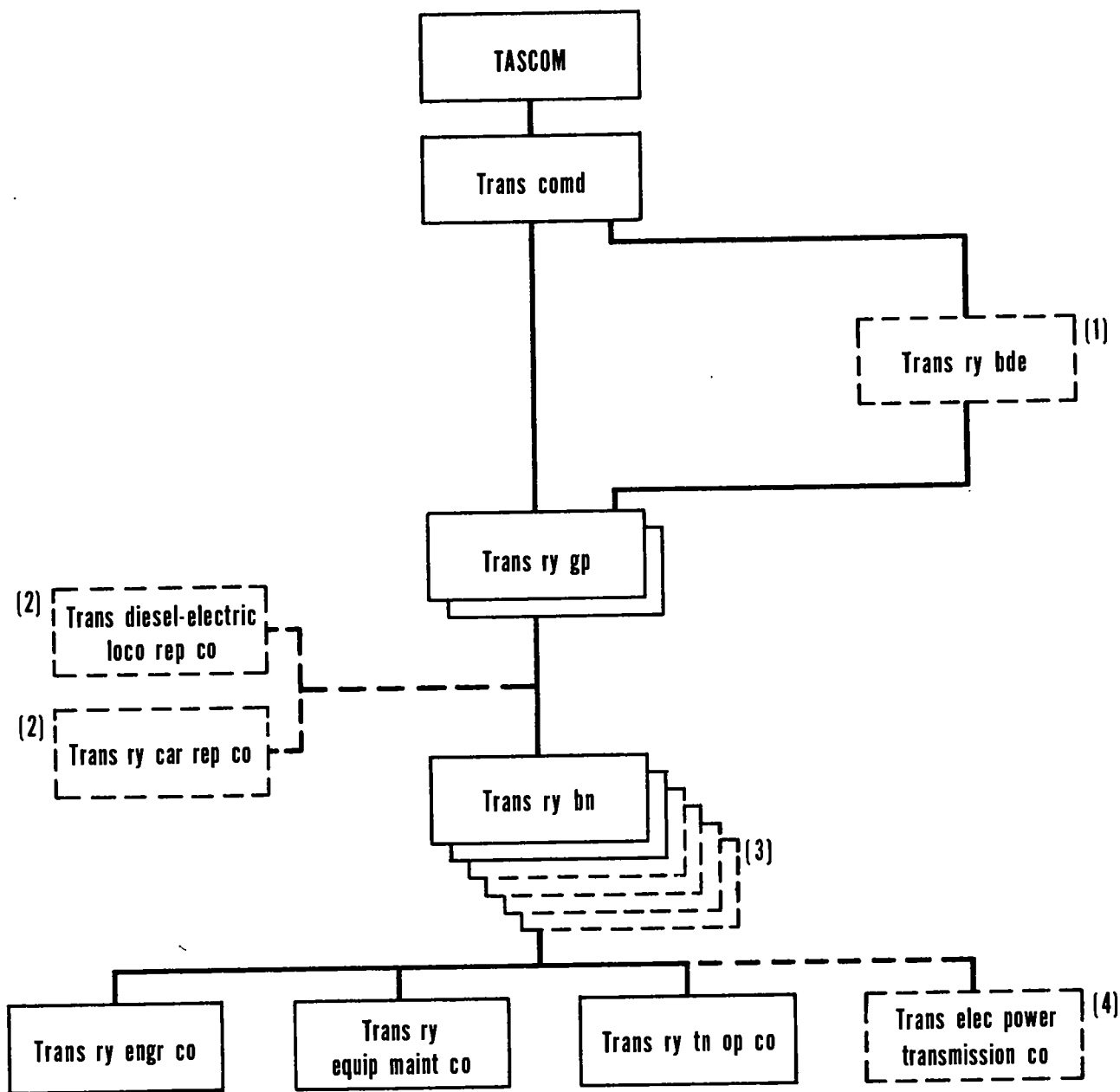
(b) Transportation railway equipment maintenance company.

(c) Transportation railway train operating company.

(d) Transportation electric power transmission company.

b. Transportation railway service teams (paras 2-11 and 2-12) organized under TOE 55-520 may be attached to the transportation railway service to provide additional support as required and as approved by the transportation command, TASCOT.

c. Two general support maintenance units that provide maintenance support on locomotives and rolling stock of the railway service—the transportation railway diesel-electric locomotive repair company and the transportation railway car repair company—are assigned to, and operate under supervision and control of, the supply and maintenance command, TASCOT, and the appropriate field depot. In view of the single-user nature of the support

**Notes:**

1. The brigade is interposed in this organization above group if three or more groups are assigned to TASCOM.
2. May be attached from the supply and maintenance command.
3. Number of battalions (two to six per group) is dependent upon the scope of the railway operation.
4. When required for electrified operations.

Figure 1-1. Type transportation railway service organization.

provided by these units, they may be attached to the railway service; in such cases, their daily operations may be controlled and supervised by the supported railway unit. One of each of these units normally is required to support a transportation railway group with its attached units. The mission of these units dictates that they be located so as to provide convenient and efficient support to the railway group (FM 29-30).

d. Military police units of the area support command provide security required beyond the capability of attached military police. Depending upon the tactical and guerrilla situation,

combat troop support may be required for protection of rail lines of communication. This support is requested through channels by the railway service as required.

1-4. Classification of Military Railways

Although contingency plans provide for the use of standard gage ($56\frac{1}{2}$ inches or 143.5 centimeters), broad gage (60 inches or 152.4 centimeters, 63 inches or 160 centimeters, 66 inches or 167.6 centimeters), narrow gage (42 inches or 106.7 centimeters, $39\frac{3}{8}$ inches or 100 centimeters), and smaller, standard gage will be used when a choice of gages is available.

CHAPTER 2

TRANSPORTATION RAILWAY UNITS

Section I. GENERAL

2-1. Introduction

a. The transportation railway service of the theater army support command (TASCOM) consists of units required to supervise, operate, and maintain the existing railway net. Railway units are no longer organic battalions but are organized on the building block principle, which permits assignment to a theater of only those units required to operate and maintain the railway net.

b. Since all supervisory and subordinate railway units in a theater are assigned to the senior transportation organization (normally a transportation command), they operate under the command and supervision of that headquarters. Subordinate transportation railway units are attached further to a railway unit at the appropriate level of command for operation and control.

c. Coordination and supervision of up to two transportation railway groups are provided by the transportation command. When the rail net must be expanded to support larger forces, the headquarters and headquarters company, transportation railway brigade, will be interposed in the organizational structure between the groups and the transportation command as a supervisory and command headquarters (fig. 1-1). The transportation railway service organization permits the assignment of only those units which are required to support a limited military operation.

d. Each transportation railway supervisory and command unit is capable of supervising and operating a railway service within the stated capability of the unit. This provides flexibility in organizing a transportation railway service since theater requirements may be met by an organization ranging from that requir-

ing a brigade headquarters, as the senior railway unit, down to a limited operation in which a battalion, as the largest railway unit, would operate a system of 90-150 track miles (145-241 kilometers).

2-2. Command and Control

Command and operational control over the entire transportation railway service is exercised by the senior transportation organization (normally a transportation command), TASCOM, regardless of the extension of this service through other commands or territorial jurisdictions in the communications or combat zones. Commanders of area support commands or areas within the combat zone influence rail operations by coordination through command and technical channels as required.

2-3. Employment

a. The transportation railway units constituting the transportation railway service operate the main rail systems in a theater of operations. Included in each system are the main line and the yards, sidings, and spur tracks required to connect the various installations to that line.

b. The transportation railway groups are assigned to and operate directly under the senior transportation organization (normally a transportation command), TASCOM. Each group administers and supervises the operation of one main rail route up to 600 miles (965 kilometers) long. The groups report directly to the railway brigade or the transportation command, which coordinates the efforts of the groups in accomplishing the theater rail mission.

c. General support maintenance of motive

power and rolling stock is provided to the group by the diesel-electric locomotive repair company and the car repair company as indicated in paragraph 1-3c.

d. The transportation railway battalion is the basic operating organization of the transportation railway service. It is the operating organization for the smallest self-contained railway segment, the railway division (geo-

graphical limits of operations, 90-150 miles or 145-241 kilometers). The headquarters and headquarters company, transportation railway battalion, is assigned to the transportation command, TASCOT, and is attached further to a railway group. The group designates the geographical limits of the division which the battalion will operate.

Section II. SUPERVISORY AND COMMAND UNITS

2-4. Headquarters and Headquarters Company, Transportation Railway Brigade (TOE 55-201)

a. *Mission.* The mission of the headquarters and headquarters company, transportation railway brigade, is to command and provide operational planning, supervision, coordination, and control of the activities of transportation railway groups.

b. *Assignment.* This unit is assigned to a TASCOT and normally is attached to a headquarters and headquarters company, transportation command.

c. *Capabilities.*

(1) Under level 1 organization, this unit provides—

(a) Command and supervision of three to seven transportation railway groups (TOE 55-202).

(b) Command of, staff planning for, and supervision of operations.

(c) Supervision and assistance in matters of administration and supply.

(d) Planning for and supervision of security of all buildings, structures, and equipment and of all supplies in transit by rail.

(e) Technical control over train movements; operation of terminals, railway shops, and enginehouses; car distribution; maintenance of track and structures; and allocation of motive power.

(f) Allocation of maintenance-of-way supplies and equipment.

(2) Under level 2 and 3 organization, the unit is adapted for reduced operational capabilities from approximately 90 percent at level 2 to 80 percent at level 3.

(3) This unit is not adaptable to a type B organization.

(4) Mobility of this unit is fixed.

d. *Characteristics.*

(1) This unit is dependent upon the personnel service company (TOE 12-67) for personnel administration, the finance direct support company (TOE 14-17) for finance service support, and the supporting headquarters and headquarters detachment, medical group, for medical staff advice and unit level medical service.

(2) A data processing team from TOE 11-500 will be required for automatic data processing support.

e. *Organization.* See figure 2-1.

f. *Employment.* The transportation railway brigade is assigned to the TASCOT transportation command. The brigade commands, plans, supervises, and controls the entire military railway system. When interzonal service is required, the brigade is authorized to operate in both the communications and combat zones. The transportation railway service is comprised of adequate supervisory, operating, and maintenance units, as required, to operate trains, to maintain rail lines of communications, and to perform organizational and direct support maintenance on motive power, rolling stock, and power transmission facilities.

2-5. Headquarters and Headquarters Company, Transportation Railway Group (TOE 55-202)

a. *Mission.* The mission of the headquarters and headquarters company, transportation railway group, is to command, administer, and

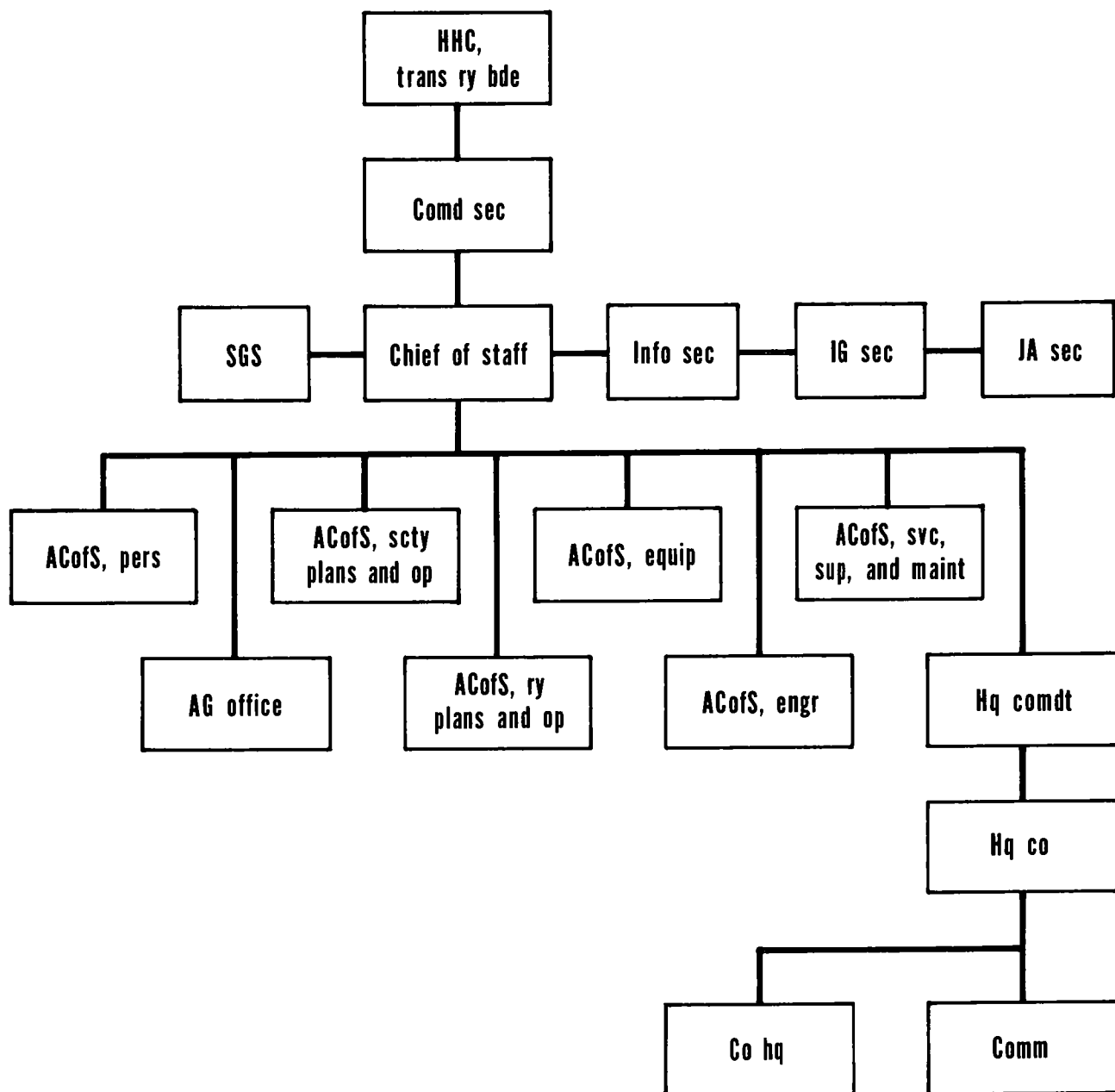


Figure 2-1. Headquarters and headquarters company, transportation railway brigade.

supervise the operation of railway battalions and attached supporting units.

b. Assignment. This unit is assigned to the senior transportation organization in the theater. It normally is attached to a headquarters and headquarters company, transportation command or transportation railway brigade.

c. Capabilities.

(1) Under level 1 organization, this unit provides the following functions for from two to six transportation railway battalions and attached supporting units as required:

(a) Command of, staff planning for, and supervision of operations.

(b) Supervision and assistance in matters of administration and supply.

(c) Planning for and supervision of security of all buildings, structures, and equipment and of all freight in transit by rail.

(d) Technical supervision over train movements; operation of terminals, railway shops, and enginehouses; car distribution; maintenance of track and structures; and allocation of motive power.

(e) Allocation of maintenance-of-way supplies and equipment.

(2) Under level 2 and 3 organization, the unit is adapted for reduced operational capabilities from approximately 90 percent at level 2 to 80 percent at level 3.

(a) Level 2 provides personnel and equipment for initiation of mission functions, but the unit must be provided level 1 authorizations for sustained performance.

(b) Level 3 provides personnel and equipment for limited performance of mission functions.

(3) This unit is not adaptable to a type B organization.

d. Characteristics.

(1) This unit is dependent upon the personnel service company (TOE 12-67) for personnel administration, the finance direct support company (TOE 14-17) for finance service support, and the supporting headquarters and headquarters detachment, medical group, for medical staff advice and unit level medical service.

(2) This unit will require attachment of a data processing team from TO 11-500 for automatic data processing support.

(3) This unit is not adaptable to a type B own organizational maintenance, except signal equipment.

e. Organization. See figure 2-2.

f. Employment. The headquarters and headquarters company, transportation railway group, commands the attached transportation railway battalions and other attached units.

2-6. Headquarters and Headquarters Company, Transportation Railway (TOE 55-226)

a. Mission. The mission of the railway battalion is to exercise command, control, and supervision over attached units and, with its attached units, to operate and maintain in a theater of operations a railway division of approximately 90-150 miles (145-241 kilometers).

b. Assignment. The headquarters and headquarters company of the railway battalion normally is assigned to the transportation command, TASCOM, and is attached to a transportation railway group. When this company is the highest railway echelon in the theater, it operates directly under the control of the senior transportation unit.

c. Capabilities.

(1) Under level 1 organization, this unit has the following capabilities:

(a) Provides command, staff planning,

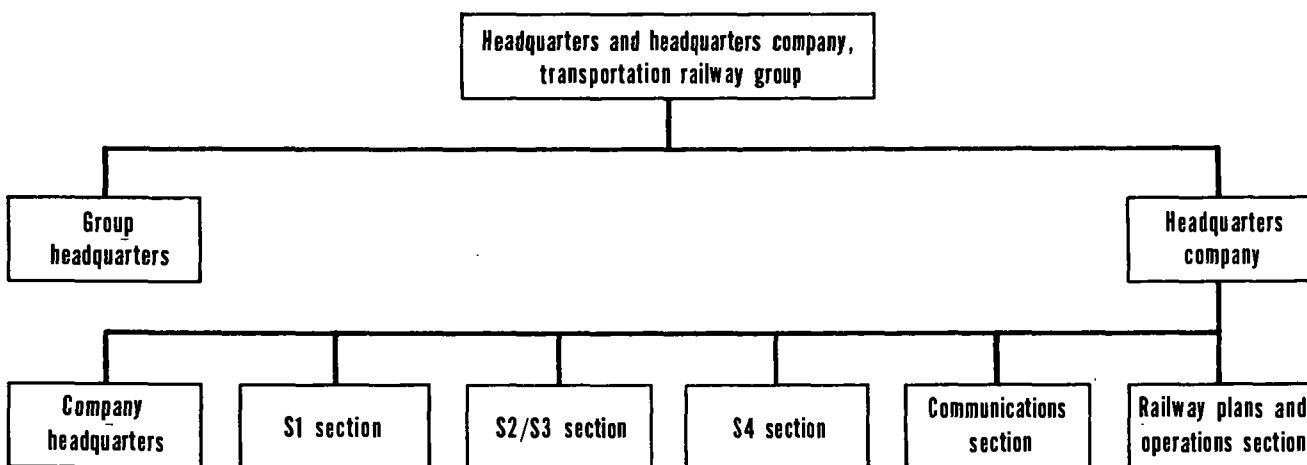


Figure 2-2. Headquarters and headquarters company, transportation railway group.

administration, control, and supervision of operations of the transportation railway battalion and assigned and attached units.

(b) Dispatches all trains operated by the battalion, supervises on-line operations, and operates railway stations and signal towers, which are the responsibility of the battalion.

(c) Maintains and repairs railway signals and communications.

(2) Under level 2 and 3 organization, the unit is adapted for reduced operational capabilities from approximately 90 percent at level 2 to 80 percent at level 3.

(3) The capabilities of a type B organization are the same as those of a level 1 organization.

(4) Mobility of this unit is fixed.

d. Characteristics.

(1) This unit is dependent upon the personnel service company (TOE 12-67) for personnel administration, the finance direct support company (TOE 14-17) for finance service support, and appropriate medical units for medical service.

(2) Individuals of this organization, except chaplain, can engage in effective, coordinated defense of the unit's area or installation. Defense of railway structures, bridges, tun-

nels, and trains in transit will require attachment of military police units.

e. Organization. See figure 2-3.

f. Employment.

(1) As the basic unit of the military railway service, the transportation railway battalion assumes responsibility for operation of a railway division (90-150 track miles (145-241 kilometers)). A railway division normally consists of main line and belt line tracks, sidings, passing tracks, terminals, enginehouses, and car repair tracks. Attached units of the railway battalion perform normal roadway maintenance and organizational and direct support maintenance to motive power, rolling stock, and railway signals, communications, and structures.

(2) The railway mileage assigned to the railway battalion will vary from 90-150 miles (145-241 kilometers); however, if military necessity dictates, the divisions may be extended. This may require attachment of teams from TOE 55-520. For planning purposes, a battalion is capable of operating an average of 10 trains daily in each direction on a single main line and 15 on a double main line between terminals of the railway division.

(3) Personnel of the headquarters and headquarters company are assigned to duties

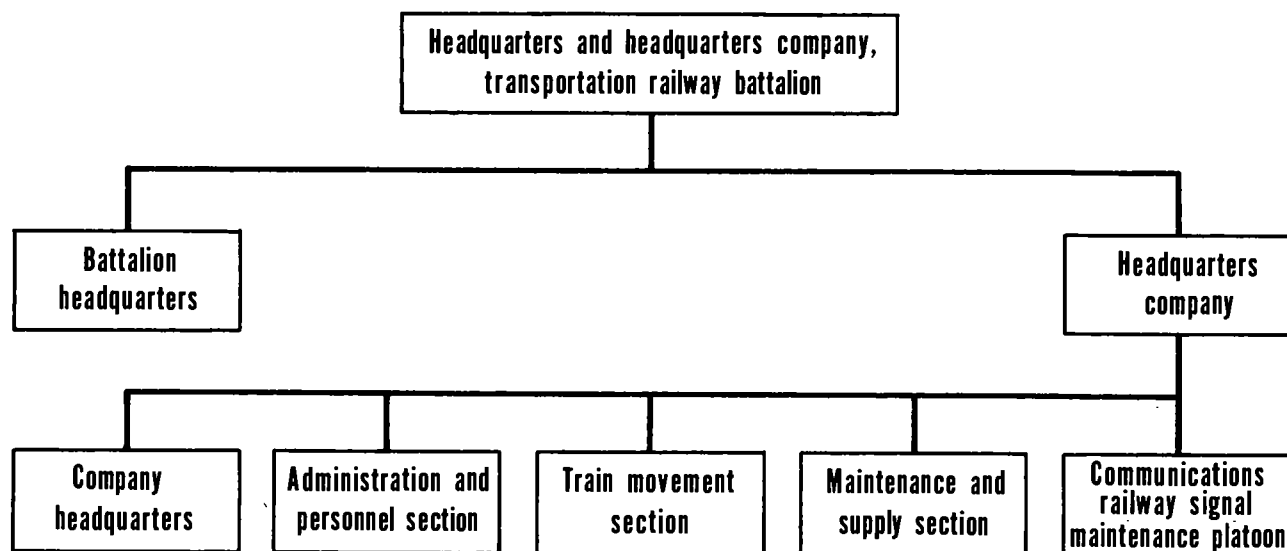


Figure 2-3. Headquarters and headquarters company, transportation railway battalion.

at locations as required for efficient operation of the railway division and according to the facilities available. Normally, the division serves at least one larger terminal. Station personnel and towermen are assigned to points along the railroad. The number of personnel at any station depends upon the amount of traffic to be handled. Personnel assignments are flexible to permit reassignment of station agents to handle any increase in traffic along any point of the division.

(4) The units normally attached to the transportation railway battalion are as follows:

(a) Transportation railway engineering company (TOE 55-227).

(b) Transportation railway equipment maintenance company (TOE 55-228).

(c) Transportation railway train operating company (TOE 55-229).

(5) When an electrified railway system is being operated, a transportation electric power transmission company (TOE 55-217) will be attached to the battalion to maintain and repair electric power transmission facilities.

(6) The units indicated in (4) and (5) above are discussed in section III below.

Section III. MAINTENANCE AND OPERATING UNITS

2-7. Transportation Railway Engineering Company (TOE 55-227)

a. Mission. The mission of the railway engineering company is to maintain and repair railroad track, bridges, and buildings within a railway division.

b. Assignment. The railway engineering company is assigned to the transportation command, theater army support command (TASCOM), and normally is attached to a headquarters and headquarters company, transportation railway battalion.

c. Capabilities.

(1) The railway engineering company is capable of providing the maintenance and repair requirements for the railway tracks, bridges, and buildings for a railway division of 90-150 miles (145-241 kilometers) operated by the transportation railway battalion to which it is attached.

(2) The reduced strength column adapts this TOE to the lesser requirements for personnel and equipment during prolonged non-combat periods and for a limited period of combat.

(3) The capabilities of a type B organization are the same as that of a full strength organization.

(a) The type B column adapts this TOE to the lesser requirements for U.S. military personnel. Vacancies existing in the type B column are indicative of the type of positions which can be filled by non-U.S. personnel. The

number of non-U.S. personnel must be determined by the major command to which the unit is assigned and will depend upon capacity of available personnel to produce, number of shifts, and other local conditions.

(b) Interpreters and translators required when organized under the type B column will be provided from appropriate teams available to the theater commander.

(c) Authorization of U.S. military personnel shown in the type B column may be modified by troop basis proponents as required by local area conditions of employment to enable the unit to accomplish its mission effectively.

d. Characteristics.

(1) The railway engineering company is not administratively self-sufficient. It is dependent upon the personnel services company (TOE 12-67) for personnel administration, the finance direct support company (TOE 14-17) for finance support, and appropriate medical units for medical support.

(2) Organic transportation is provided for administrative, logistic, and supervisory missions. This unit cannot move itself with its organic motor transportation.

e. Organization. See figure 2-4.

f. Employment. The railway engineering company normally is attached to and operates under the command and supervision of a headquarters and headquarters company, transportation railway battalion; normal attachment is one company to a battalion. It performs main-

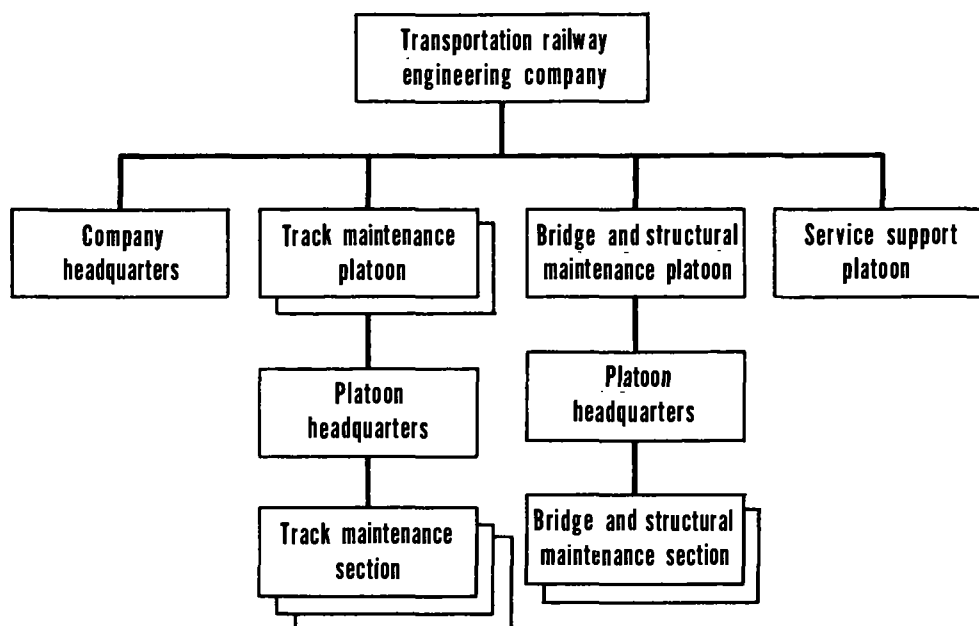


Figure 2-4. Transportation railway engineering company, transportation railway battalion.

tenance and repair on track, bridges, and structures of a railway division on a 24-hour basis. Maintenance and repair include inspection of track, roadbeds, signals, bridges, culverts, buildings, water towers, and other railway structures to determine the extent and nature of maintenance and required repairs. When major construction and/or rehabilitation beyond the capability of this unit is required, the senior railway headquarters in the theater requests and coordinates the support requirement with the theater engineer command. In a major construction or rehabilitation project, the railway engineering company cooperates closely with engineer units and when directed aids them in accomplishing their assigned task.

2-8. Transportation Railway Equipment Company (TOE 55-228)

a. Mission. The mission of the railway equipment maintenance company is to provide organizational and direct support maintenance on motive power and rolling stock.

b. Assignment. The equipment maintenance company is assigned to the transportation com-

mand, TASCOM, and normally is attached to a transportation railway battalion.

c. Capabilities.

(1) The equipment maintenance company is capable of performing organizational and direct support maintenance to approximately 40 diesel-electric locomotives and 800 railway cars and can perform organizational (running) inspection on 2,000 cars daily. It performs light repairs on tools and limited repairs on special mechanical equipment within the battalion.

(2) The reduced strength column adapts this TOE to the lesser requirements for personnel and equipment during prolonged noncombat periods and for a limited period of combat.

(3) The capabilities of a type B organization are the same as those of a full-strength organization.

(a) The type B column adapts this TOE to the lesser requirements for U.S. military personnel. Vacancies existing in the type B column are indicative of the types of positions which can be filled by non-U.S. personnel. The number of non-U.S. personnel must be determined by the major commander to which

the unit is assigned and will depend upon capacity of available personnel to produce, number of shifts, and other local conditions.

(b) Interpreters and translators required when organized under the type B column will be provided from appropriate teams available to the theater commander.

(c) Authorization of U.S. military personnel shown in the type B column may be modified by troop basis proponents as required by local area conditions of equipment to enable the unit to accomplish its mission effectively.

(4) Mobility of this unit is fixed.

d. Characteristics.

(1) The equipment maintenance company is not administratively self-sufficient. It is dependent upon the personnel services company (TOE 12-67) for personnel administration, the finance direct support company (TOE 14-17) for finance support, and appropriate medical units for medical services.

(2) Organic transportation is provided for administrative, logistic, and supervisory missions. This unit cannot move itself with its organic motor transportation.

e. Organization. See figure 2-5.

f. Employment. The railway equipment maintenance company is attached to and operates under the command and supervision of a headquarters and headquarters company, transportation railway battalion; normal attachment is one company to a battalion. Upon entry into a theater of operations, equipment maintenance personnel inspect available motive power and rolling stock and estimate the

time required to place them in service; equipment requiring repairs beyond the capability of the unit is evacuated to the general support units for repair. Personnel of the railway equipment maintenance company also inspect enginehouses, shops, fueling and watering stations, and other facilities used in rolling stock maintenance. During subsequent operations, motive power and railway cars are kept in proper operating condition by performance of organizational and direct support maintenance as required. Personnel of this unit operate a wreck train to clear the tracks and to repair or salvage derailed or wrecked motive power and cars. This unit also maintains the necessary level of diesel fuels and other supplies of lubricants, oils, solvents, and repair parts for organizational and direct support maintenance on motive power and rolling stock and operates fueling, watering, and lubricating facilities. When necessary, this unit implements the battalion demolition plan for the destruction of shop equipment, motive power, and railway cars (see STANAG 2113).

2-9. Transportation Railway Train Operating Company (TOE 55-229)

a. Mission. The mission of the train operating company is to provide road and yard personnel for the operation of railway locomotives and trains.

b. Assignment. The train operating company is assigned to the transportation command, TASCOT, and normally is attached to a transportation railway battalion.

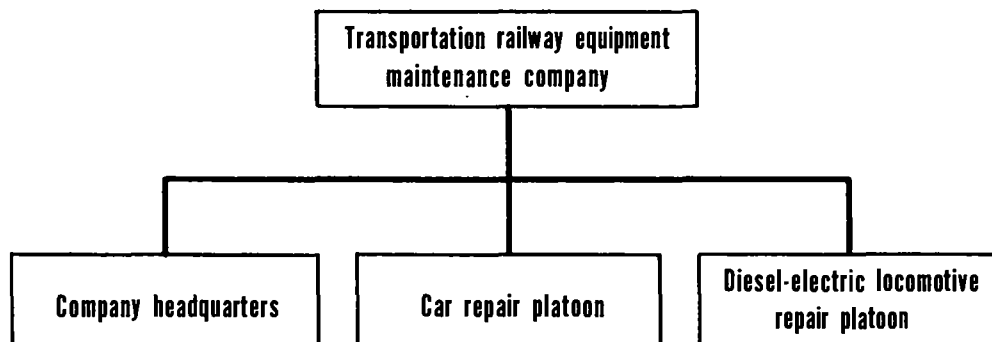


Figure 2-5. Transportation railway equipment maintenance company, transportation railway battalion.

c. Capabilities.

(1) Under level 1 organization, this unit has the following capabilities:

(a) Operates trains and locomotives in both yard and road service and performs incidental switching service for a railway division 90-150 miles (145-241 kilometers) long on an around-the-clock basis.

(b) Performs the necessary switching and train buildup in a large terminal, including port clearance up to a 20-mile radius from a large port.

(c) Provides 40 train crews daily for road and/or terminal operation, including switching, classifying, and making up trains for the road.

(2) Under level 2 and 3 organization, this unit is adapted for reduced operational capabilities from approximately 90 percent at level 2 to 80 percent at level 3.

(3) The capabilities of a type B organization are the same as those of a level 1 organization.

(a) The type B column adapts this TOE to the lesser requirement for U.S. military personnel. Vacancies existing in the type B column are indicative of the types of positions which can be filled by non-U.S. personnel. The number of non-U.S. personnel must be determined by the major commander to which the unit is assigned and will depend upon capacity of available personnel to produce, number of shifts, and other local conditions.

(b) Interpreters and translators required when organized under the type B column will be provided from appropriate teams available to the theater commander.

(c) Authorization of U.S. military personnel shown in the type B column may be modified by troop basis proponents as required by local area conditions of employment to enable the unit to accomplish its mission effectively.

d. Characteristics.

(1) The train operating company is dependent on the personnel service company (TOE 12-67) for personnel administration and upon the finance direct support company (TOE 14-17) for finance service support.

(2) Organic transportation is provided for administration, logistic, and supervisory

missions. This unit cannot move itself with its organic motor transportation.

e. Organization. See figure 2-6.

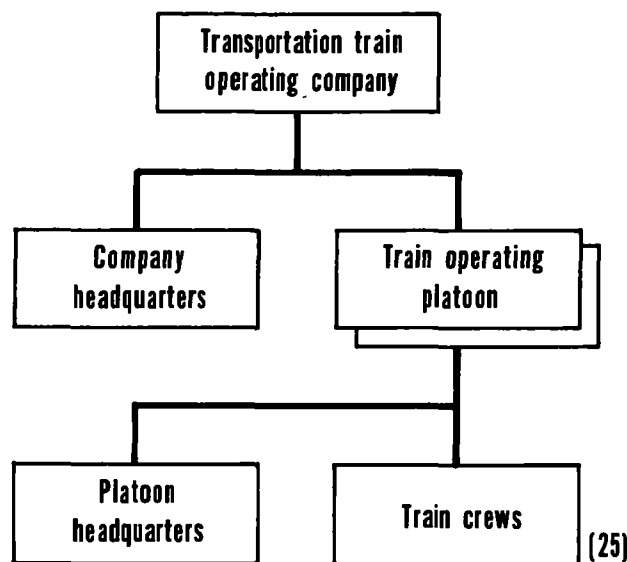


Figure 2-6. Transportation train operating company, transportation railway battalion.

f. Employment. The train operating company provides train crew personnel for operation of main line freight and passenger trains and yard crew personnel for switching requirements in yards and terminals, including yardmasters and yard clerks. Train crews in main line service are supervised by assistant trainmasters and road foremen of engines. Operational control of all main line trains is exercised by the train dispatcher. While within yard limits, they are under the supervision of the yardmaster.

2-10. Transportation Electric Power Transmission Company (TOE 55-217)

a. Mission. The mission of the electric power transmission company is to maintain and repair electric power transmission facilities.

b. Assignment. The electric power transmission company is assigned to the transportation command, TASCOT, and normally is attached to a transportation railway battalion.

c. Capabilities.

(1) Under level 1 organization, this unit maintains and repairs electric power transmis-

sion facilities, including substation and catenary, for 200 miles (321 kilometers) of electrified railway, including side tracks, passing tracks, and yard tracks.

(2) Under level 2 and 3 organization, the unit is adapted for reduced operational capabilities for approximately 90 percent at level 2 to 80 percent at level 3.

(3) The capabilities of a type B organization are the same as those of a level 1 organization.

(a) The type B column adapts this table to the lesser requirements for U.S. military personnel. Vacancies existing in the type B column are indicative of the types of positions which can be filled by non-U.S. personnel. The number of non-U.S. personnel must be determined by the major commander to which the unit is assigned and will depend upon capacity of available personnel to produce, number of shifts, and other local conditions.

(b) Interpreters and translators required when organized under the type B column will be provided from appropriate teams available to the theater commander.

(c) Authorization of U.S. military personnel shown in the type B column may be modified by troop basis proponents as required by local area conditions of employment to enable the unit to accomplish its mission effectively.

d. Characteristics.

(1) This unit is dependent upon a personnel service company (TOE 12-67) for personnel services and upon the finance direct support company (TOE 14-17) for finance services support.

(2) Organic transportation is provided for administrative, logistic, and supervisory missions and provide the unit with a 15-percent mobility capability.

e. Organization. See figure 2-7.

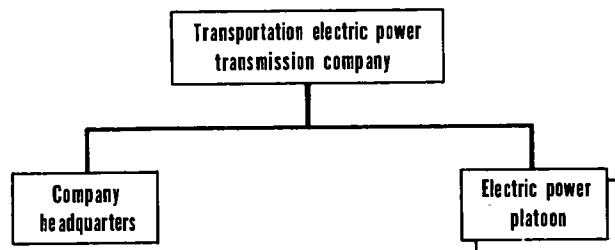


Figure 2-7. Transportation electric power transmission company.

f. Employment. The electric power transmission company normally is attached to a transportation railway battalion. It is employed only when an electrified system is to be operated and when such operation cannot be accomplished by using local civilian personnel.

Section IV. TRANSPORTATION RAILWAY SERVICE TEAMS

2-11. General

Transportation service teams organized under TOE 55-520 are available for employment within the transportation railway service. These teams are employed to increase the capabilities of railway service operating and maintenance units to meet requirements that exceed the capabilities of such units but are not sufficient to warrant the assignment of additional TOE units to the railway service.

a. *Mission.* The missions of individual teams are given in paragraph 2-12 below.

b. *Assignment.* Assignment of individual teams is given in paragraph 2-12 below. Team may be attached or assigned as required to higher echelon units or may be organized

into service units to perform the functions required by existing conditions.

c. Capabilities.

(1) Capabilities for individual teams are given in paragraph 2-12 below.

(2) These teams are not adaptable to strength levels 2 and 3.

(3) These teams are not adaptable to type B organization except as noted for specific teams in paragraph 2-12 below.

(4) When type B strength is shown, the capabilities are the same as those of a full strength organization.

(a) The type B column adapts the teams to the lesser requirements for U.S. military personnel. Vacancies existing in the type

B column are indicative of the types of positions which can be filled by non-U.S. personnel. The number of non-U.S. personnel must be determined by the major commander to which the unit is assigned and will depend upon capacity of available personnel to produce, number of shifts, and other local conditions.

(b) *Interpreters and translators* required when organized under type B strength will be provided from appropriate teams available to the theater commander.

(c) *Authorization of U.S. military personnel* shown in the type B column may be modified by troop basis proponents as required by local area conditions of employment to enable the unit to accomplish its mission effectively.

(5) Unless specifically provided for in the individual teams, these teams must be furnished personnel, administration, supply, mess, and organizational maintenance service. If not provided by the unit to which attached or assigned, mess and automotive maintenance teams will be drawn from TOE 29-500 or 29-510. Other service support will be drawn from appropriate service organization TOE of the service concerned or provided on an area basis as required. Teams may be grouped under appropriate TOE 55-500 headquarters elements for command control.

d. *Basis of allocation.* Basis of allocation is given for individual teams in paragraph 2-12 below.

e. *Category.* These teams are designated as category III teams (AR 320-5).

f. *Mobility.* Mobility for individual teams is given in paragraph 2-12 below.

2-12. Detailed Breakdown of Teams

a. *Team EA, Ambulance Train Maintenance Detachment (Direct Support).*

(1) *Mission.* To perform running repairs on ambulance train railway cars.

(2) *Assignment.* To the senior transportation railway unit in a theater of operations.

(3) *Capabilities.* Performing running repairs on one ambulance train.

(4) *Basis of allocation.* One per ambulance train.

(5) *Mobility.* One hundred percent mobile by rail.

b. *Team EB, Ambulance Train Maintenance Detachment (Augmentation).*

(1) *Mission.* Augmenting railway car repair crew when required to perform direct support maintenance repairs on ambulance trains.

(2) *Assignment.* To a railway car repair crew (direct support).

(3) *Capabilities.* Provides refrigeration and supply specialists necessary for direct support maintenance of four ambulance trains.

(4) *Basis of allocation.* One per four ambulance trains to be maintained.

(5) *Mobility.* Fixed.

c. *Team EC, Railway Station Detachment.*

(1) *Mission.* To operate an on-line railway station.

(2) *Assignment.* To a transportation railway battalion or comparable unit.

(3) *Capabilities.*

(a) Providing a detachment to operate a small or medium-size on-line railway station facility in a depot or other installation served by the transportation railway service.

(b) Augmenting a transportation railway battalion.

(4) *Basis of allocation.* One for each on-line railway station or depot railway station facility required when the number of such stations to be operated exceeds the capabilities of a transportation railway battalion.

(5) *Mobility.* Fixed.

d. *Team ED, Railway Terminal Detachment.*

(1) *Mission.* To operate a railway terminal on a 24-hour basis.

(2) *Assignment.* To a transportation railway battalion or comparable unit.

(3) *Capabilities.* Operating a railway terminal with a capacity of 10 trains per day.

(4) *Basis of allocation.* One per railway terminal when the number of such terminals to be operated exceeds the capabilities of a transportation railway battalion.

(5) *Mobility.* Fixed.

e. *Team EE, Railway Section Crew.*

(1) *Mission.* To perform railway maintenance of way.

(2) *Assignment.* To a transportation railway battalion, or comparable unit.

(3) *Capabilities.*

(a) Maintaining approximately 15 track miles (tracks, roadbeds, switches, and miscellaneous railway facilities).

(b) Adaptable to type B organization.

(4) *Basis of allocation.* As required in consonance with stated capability.

(5) *Mobility.* One hundred percent mobile by rail.

f. Team EF, Steam Locomotive Maintenance Detachment (Direct Support).

(1) *Mission.* To perform direct support maintenance on steam locomotives.

(2) *Assignment.* To a transportation railway battalion or comparable unit.

(3) *Capabilities.*

(a) Performing direct support maintenance for seven steam locomotives.

(b) Adaptable to a type B organization.

(4) *Basis of allocation.* One per seven steam locomotives for which the U.S. Army has direct support maintenance responsibility.

(5) *Mobility.* Fixed.

g. Team EG, Diesel-Electric Locomotive Maintenance Detachment (Direct Support).

(1) *Mission.* To perform direct support maintenance on diesel-electric locomotives.

(2) *Assignment.* To a transportation railway battalion or comparable unit.

(3) *Capabilities.*

(a) Performing direct support maintenance for seven diesel-electric locomotives and 50 railway cars at a small terminal.

(b) Augmenting a transportation railway battalion.

(4) *Basis of allocation.* One per seven diesel-electric locomotives and 50 railway cars requiring direct support maintenance when direct support maintenance requirements for diesel-electric locomotives exceed the capabilities of a transportation railway battalion.

(5) *Mobility.* Fixed.

h. Team EH, Railway Car Repair Crew (Direct Support).

(1) *Mission.* To inspect and perform direct support maintenance on railway cars at points distant from fixed facilities.

(2) *Assignment.* To a transportation railway battalion or comparable unit.

(3) *Capabilities.*

(a) Inspecting and performing direct

support maintenance on 300 to 350 railway cars.

(b) Augmenting a transportation railway battalion.

(c) With augmentation by ambulance train maintenance team, capable of performing direct support maintenance on ambulance trains.

(d) Adaptable to a type B organization.

(4) *Basis of allocation.* One per 300 to 350 railway cars for which inspection and maintenance are required beyond the capabilities of other railway maintenance units.

(5) *Mobility.* Fixed.

i. Team EI, Railway Yard Operating Detachment.

(1) *Mission.* To operate a railroad yard.

(2) *Assignment.* To a transportation railway battalion or comparable unit.

(3) *Capabilities.*

(a) Operating a railroad yard on a 24-hour basis when yard train crews are provided and when not more than two receiving and classification yards, including humps, are to be operated.

(b) Inspecting and performing running repairs on rolling stock transiting the yard.

(c) Inspecting and, as necessary, adjusting or securing loads on cars passing through the yard.

(d) Augmenting a transportation railway battalion.

(4) *Basis of allocation.* One per railroad yard of 500-cars-per-day capacity when the number of such yards to be operated exceeds the capabilities of a transportation railway battalion.

(5) *Mobility.* Fixed.

j. Team EJ, Bridge and Building Maintenance Detachment (Direct Support).

(1) *Mission.* To maintain railway bridges and buildings.

(2) *Assignment.* To a transportation railway battalion or comparable unit.

(3) *Capabilities.*

(a) Maintaining bridges and buildings along 45 to 75 track miles.

(b) Adaptable to type B organization.

(4) *Basis of allocation.* As required in consonance with stated capability.

(5) *Mobility*. Fifty percent mobile by organic vehicles and rail equipment.

k. Team EK, Railway Train Operating Section.

(1) *Mission*. To operate trains.

(2) *Assignment*. To a transportation railway battalion or comparable unit.

(3) *Capabilities*. Operating three trains on a 24-hour basis in either road or switching service.

(4) *Basis of allocation*. As required in consonance with stated capability.

(5) *Mobility*. Fixed.

l. Team EL, Railway Workshop (Mobile) Detachment (Direct Support).

(1) *Mission*. To perform direct support maintenance of diesel-electric locomotives and rolling stock in areas where static facilities are inadequate or nonexistent.

(2) *Assignment*. To a headquarters and headquarters company, transportation railway group, or to a transportation railway battalion or comparable unit.

(3) *Capabilities*.

(a) Performing the following functions on a 24-hour daily basis:

1. Inspecting and performing direct support maintenance on 20 diesel-electric locomotives and 100 railway cars.

2. Assembling railway equipment.

(b) Adaptable to a type B organization.

(4) *Basis or allocation*. One per transportation railway battalion or as required.

(5) *Mobility*. One hundred percent mobile when equipment is mounted on railroad cars.

m. Team EM, Railway Maintenance-of-Way Crew.

(1) *Mission*. To perform maintenance-of-way functions.

(2) *Assignment*. To a transportation railway battalion or comparable unit.

(3) *Capabilities*.

(a) Maintaining approximately 40 track miles (including track, bridges, buildings, and railway signals and communications lines) in a large terminal area.

(b) Adaptable to type B organization.

(4) *Basis of allocation*. As required in consonance with stated capability.

(5) *Mobility*. Fifty percent mobile by organic vehicles and rail equipment.



CHAPTER 3

RAILWAY OPERATIONS

(STANAG 2158)

3-1. Establishment of Rail Operations

The normal procedure for the establishment of railway operation in a theater of operations is set forth in subparagraphs *a-e* below. Since establishment of operations is dependent upon the rehabilitation of the railway net, the following steps may be accomplished simultaneously. After railway personnel and equipment arrive in an area, limited railway operations may be established within a few hours.

a. All rail lines, facilities, and equipment are reconnoitered by a team of railway and engineer personnel. This reconnaissance must produce sufficient intelligence of the rail line, the condition of existing facilities and equipment, and the availability of civilian railway personnel on which to base requirements for personnel and equipment for operation of the rail system.

b. The capabilities and limitations of the rail line are evaluated.

c. Subordinate rail units are oriented concerning the characteristics of the rail lines and the type of operation planned.

d. Subordinate rail units are deployed throughout the rail net.

e. Rail operations are initiated.

3-2. Methods of Operation

a. Existing railway facilities in a theater will be operated as required to support the military operations. It may be expected that communications and railway signal facilities, to include any form of centralized traffic control, electrically operated interlocking plants, and automatic block signal systems, will be damaged, destroyed, or inoperative. The introduction of U.S. radio-equipped locomotives will assist greatly in rail operations before the resto-

ration of damaged or destroyed signal communications.

b. The methods by which trains are operated in a theater include fleet, block (positive or permissive), train order, and timetable operations or a combination of these methods.

(1) Fleet operation entails forward movement of loaded trains only during a given period (4, 8, 12, or 24 hours) and return movement of empty trains only during a succeeding like period over the same track or route. Fleet operation also may entail the movement of loaded trains over one route and the return of empty trains over another route.

(2) Block operation may be positive or permissive. In positive block operation, a train may not enter a block that already is occupied by another train. In permissive block operation, more than one train proceeding in the same direction may occupy a block at the same time.

(3) Train order operation is employed when communications are adequate and dependable and sufficient sidings and passing tracks are available. In train order operation, the dispatcher controls movements by issuing train orders.

(4) Timetable operation is employed when rail traffic in a theater becomes generally stabilized. The timetable is the authority for movement of regular trains subject to the rules. It contains the schedules of regular trains with special instructions relating thereto.

3-3. Operating and Safety Rules

a. Operating Rules.

(1) Train operations are governed by current railway operating technical manuals based on the Standard Code of Train Rules is-

sued by the Association of American Railroads (TM 55-200). The rules will be modified to apply to conditions in a theater of operations.

(2) Correct interpretation, proper application, and observance of these operating rules are of primary importance in efficient and safe operation of the railroad.

b. Safety Rules. Safety rules applicable to transportation railway service personnel in the performance of duties are published in appropriate military publications (DA Pam 55-1). Every member of the transportation railway service is required to familiarize himself with these rules and to obey them.

3-4. General Types of Trains

The two general types of trains that normally are operated are classified by the nature of their cargo and in some instances by their equipment:

a. Passenger trains move personnel, mail, and express on through (long) or local runs.

b. Freight trains operate as long-haul freight carriers, local freight carriers, or work trains.

3-5. Operation of Ambulance Trains

Ambulance trains (utility cars, ward cars, and kitchen cars) authorized by TOE 8-520 and two-car diesel trains are medical property but are moved and maintained by the transportation railway service. Schedules are prepared by the transportation railway service to meet the requirements of the theater army support command (TASCOM) medical command. Ambulance trains are stabled where they can be maintained as complete 10-car trains and where they can be best serviced and deployed by both medical facilities and the transportation railway service. Special stabling areas, sidings, and spurs may be required. Train commanders of ambulance trains normally are officers of the Army Medical Service. Engineers, train crews, and locomotives are provided by the transportation railway service.

a. Priority. Ambulance trains normally take priority over all other trains except those being run under emergency conditions for the express purpose of supporting a force in actual combat.

b. Immunity. Red Cross markings, displayed in accordance with Geneva Convention agreements, afford the train immunity from enemy action. Geneva Convention agreements also specify who (normally noncombatants) may ride ambulance trains. Generally, riders are restricted to train operating crews, medical staffs, and patients.

c. Limits of Operation. Ambulance trains normally operate from a railhead or collecting point in the army area to an evacuation port or to hospitals in the rear of the army area, depending upon the theater evacuation policy and instructions of the medical regulating officer, medical command. They may, when required, operate as far forward as the division rear.

d. Coordination. The medical command makes requests and indicates requirements for the movement of ambulance trains through the local movements officer. The locations of train stabling points are determined by coordination between the medical command and the transportation railway service.

3-6. Speed of Train Movements

In the initial stages of an operation, trains operate at slow or moderate speeds. Safe arrival at destination is the primary consideration in railway operations. As the theater expands, as facilities and equipment are improved, and as operating personnel become familiar with the areas in which they are operating, train speeds may be increased.

3-7. Yard and Terminal Operations

In general usage, a yard is a system of tracks used in breaking up, classifying, storing, and making up trains. Yards are located at ports, interchange points, large depots, and forward railheads. A rail terminal includes, in addition to yard tracks, facilities for repair and service and for accommodation of railway crews. Terminals are located at originating and terminating points of trains and at sites which mark the limits of the operating divisions. They may consist of one or more yards.

a. When only one yard is available to receive trains and classify cars, it is designated as a combination yard. In a combination yard, trains are received, cars are classified, and

made-up trains depart from the single yard or terminal facility. One disadvantage of the combination yard is that the minute-to-minute operation prevents specific track assignments before arrival of an inbound train.

b. When a terminal consists of more than one yard, functions generally are divided as follows:

(1) The receiving or inbound yard clears trains from the main line to avoid blocking the line.

(2) In the classification yard, trains are broken up, cars are classified according to commodity and destination, and new trains are made up.

(3) In the outbound or forwarding yard, trains are made ready for departure after being classified.

c. In addition to the yards designated in *b* above, a terminal may contain the following special purpose tracks or yards:

- (1) Storage tracks or yards.
- (2) Coach tracks or yards.
- (3) Repair tracks or yards.
- (4) Stock tracks or yards.
- (5) Industrial tracks or yards.
- (6) Team tracks or yards.
- (7) Scale tracks or yards.
- (8) Shop tracks or yards.
- (9) Engine tracks or yards.
- (10) Caboose tracks or yards.

3-8. Assignment of Motive Power and Rolling Stock

a. *Road Engines.* Road engines are assigned to the transportation railway group at a ratio of approximately 40 engines per attached battalion. This number may be increased or decreased based upon the number and type of trains to be operated; the physical characteristics of the division; and the water, fuel, and servicing facilities available.

b. *Switch Engines.* Switch engines are assigned to yards and terminals according to the following general criteria:

(1) Installations and depots—one per 67 cars dispatched and received per day.

(2) Railheads—one per 67 cars dispatched and received per day.

(3) Intermediate yards and handling ter-

minals—one per 100 cars passing or handled per day.

c. *Rolling Stock.* Rolling stock is assigned to the transportation railway groups and will be used over the entire system. Work equipment may be assigned to transportation railway battalions as required for use on their divisions.

3-9. Interruptions to Rail Traffic

a. The transportation railway service is responsible for clearing all interruptions to rail traffic as quickly as possible. Assistance, as required, may be obtained from the engineer command, communications personnel, and local civilians. Major interruptions to rail traffic must be reported immediately to the commander, transportation railway group or brigade, so that required adjustments may be made in the traffic flow.

b. Major causes of rail traffic interruptions are as follows:

(1) Enemy action, including aerial bombing and artillery fire utilizing either conventional or nuclear weapons, and guerrilla activity.

(2) Human failure, including improper train operation, violation of rules, and improper inspection and maintenance of equipment.

(3) Equipment or facility failure due to unforeseen or unpredictable equipment faults or defects.

(4) Natural causes, including floods, slides, washouts, lightning fires, etc.

c. Types of interruptions are indicated by their major cause and derivatives thereof and include, but are not limited to, major derailments, minor derailments, washouts, floods, slides, tunnel cave-ins, and guerrilla action.

3-10. Use of Equipment

a. Effective and adequate transportation railway support of military operations in a theater requires efficient utilization of railway rolling stock and motive power. Commanders responsible for loading and unloading cars must supervise closely to insure that railway rolling stock is released promptly.

b. Passenger equipment frequently is limited to use in troop movements, leave trains,

military casual personnel trains, and ambulance trains.

c. Special equipment includes not only specially designed rolling stock for handling unusual cargo, but also railway work equipment and ambulance cars. If standard Department of the Army ambulance cars are not furnished in a theater of operations, passenger equipment may be converted to ambulance cars.

d. When volume permits, refrigerator or tank cars are handled in solid trains and given a high movement priority from origin to destination and return.

3-11. Operational Control by Higher Headquarters

a. The transportation command exercises control over the movement by rail of troops and supplies within the theater of operations.

b. The transportation command exercises control over the allocation and utilization of rail equipment used in the movement of troops and supplies within the theater of operations.

3-12. Personnel Movements

a. *General.* Programed and unprogramed troop movements generally create a heavy demand for rolling stock; therefore, sufficient lead time should be allowed to the railway service to permit ordering and assembling equipment for such operations. Normally, troop movements are made from selected entraining areas, generally in the vicinity of a troop staging or training area, to prevent congestion of rail facilities required for supply movements. When troop movements are made in freight equipment and long distances are involved, arrangements are made through the local transportation movements office (FM 55-4) to select and schedule stopover points en route for messing and relief of troops. For large troop moves, movements personnel schedule the departure over several days when possible. This minimizes requirements for concentration of troops and equipment and permits reuse of the same railway equipment in a shuttle movement.

b. *Authorization for Rail Travel.* Normally, the movement control center receives information on troop arrivals in the theater and on intra-theater troop movements. Based on priori-

ties established by the theater commander, the movement control center prepares a troop movement program for issue by the TASCOC commander. This program is a directive for the accomplishment of troop movements during a specific period of time and includes directives for the rail portion of the movement program.

c. *Troop Movement Procedures.* The normal procedure for troop movement by rail is as follows:

(1) Orders directing the movement are delivered to the local transportation movements officer by the commander of the unit directed to move.

(2) The local transportation movements officer obtains the following information from the commander and transmits it by the most expeditious means available to the passenger branch, movement control center, which contacts the appropriate rail unit (FM 55-4).

(a) Authority for the move.

(b) Number of personnel.

(c) Point of origin.

(d) Destination.

(e) Date of departure or date due at destination.

(f) Quantity of baggage and/or unit equipment.

(3) Based upon the above information, the movement control center is provided the following information by the railway service:

(a) Route.

(b) Schedule.

(c) Type and quantity of rail equipment to be provided.

(d) Time and place of entraining.

(e) Transfer points, if required.

(f) Time and place of detraining.

(g) Rest stops, if required.

(4) The movement control center assigns a military authorization identification number (international code number, as shown in STANAG 2158), to identify the movement and transmits, through movement control channels, details of the itinerary to the unit being moved (FM 55-4). Appendix H contains this STANAG.

(5) The appropriate railway unit transmits details of the itinerary to all transporta-

tion railway service activities concerned and insures that rail equipment is made available when required and that trains are operated as scheduled.

3-13. Supply Movements

a. Movement Documentation.

(1) *Transportation movement program.* The authority for movement of supplies by rail is contained in the transportation movement program, which also provides the authority for shippers to request transportation from the local transportation movements officer. The movement program is a directive, normally prepared by the TASCOM movement control center and issued in the name of the TASCOM commander, for the accomplishment of movements during a specific period of time. This program provides the means by which shippers, receivers, and transport services are advised of movement priorities, designated transport modes, and schedule of movements. It enables them to prepare to carry out shipments at the time and in the order specified.

(2) *Material release order.* The inventory control center normally issues a material release order to shippers concerned with movements, with a copy furnished to the movement control center by computer-to-computer link. The material release order contains details on what is to be shipped and origin and destination of shipment. It assists personnel by providing information not contained in the movement program or by clarifying information included in the program.

(3) *Transportation movement release.* This is the release issued by the movement control organization to identify a particular shipment. It normally is issued after the consignor has requested transport and the capability of the transport mode to move the shipment has been determined.

(a) Transportation movement releases are issued on all release-lot shipments; these are shipments which, by command criteria, must be offered to the movements management organization for shipment. Normally, a release-lot shipment is one that is either over a specific weight or that occupies the total visible

capacity of the transport mode carrier, or any shipment that is outsized or overweight.

(b) Shipments of less than release-lot criteria may either be consolidated by the shipper to meet release-lot criteria or, if there is insufficient material for a single destination to meet such criteria, it may be offered to the nearest transportation consolidation and distribution point for movement (FM 55-4).

(c) Transportation movement releases are issued for both programed and unprogramed shipments.

(4) *Military authorization identification number.* Military authorization identification numbers are assigned to groups of 15 or more persons moving in railway passenger or mixed train service. When camp equipage, emergency ammunition, or other property of military agencies generally known as impedimenta is moved by rail, it is assigned the symbol MI (military impedimenta).

b. Ordering Rail Transport.

(1) Shipping agencies place their requirements for rail transport through their local transportation movements officer or, when authorized, through the local railway operating representative (normally collocated) a minimum of 24 hours before loading time. This affords a more economical use of switch engines and rolling stock in the car-spotting and switching operations involved.

(2) For requirements placed by the medical regulating officer, medical command, for movement of ambulance trains, the 24-hour minimum time factor does not apply; however, adequate notification enables operating personnel to respond more efficiently to requirements placed on them.

c. Loading Rail Cars.

(1) The shipper must load rail cars to the maximum capacity consistent with safe tonnage or with space limitations.

(2) Blocking and bracing of loads is accomplished by the shipper.

(3) Inspection of lading of open top cars for safety of movement is a responsibility of the appropriate railway unit.

(4) When loads on flatcars exceed the designated height and/or width limitation re-

quirement, special clearance must be obtained for the route of the movement.

(5) Many foreign-manufactured car designs require an equal weight distribution of the load on the car floor. Whn concentrated

weights (for example, armored vehicles) are loaded, the proper type of car must be ordered and the weight of the load must be distributed to comply with the rated capacity of the car.

CHAPTER 4

OPERATIONAL CONSIDERATIONS IN A THEATER OF OPERATIONS

(STANAG 2805E, Annex B)

4-1. General

Military forces may use all available operational railways in the theater. Since railways are extremely vulnerable to continued damage and destruction by hostile aircraft, guerrilla action, and sabotage, an adequate rail system must be planned, including alternate routes and means of bypassing obstructions, to provide a continuous service. The provisions of STANAG 2805E, Annex B (app F) apply to railway operations in continental Western Europe.

4-2. Location

The location of existing railway lines is of great strategic importance. Main line routes, together with required yards, sidings, and short spur tracks required to connect the various installations with the main lines, are selected. Railways in the rear of the main line of resistance and parallel to it are used where possible for lateral movement of troops and supplies.

4-3. Desirable Characteristics

a. The following are important considerations when selecting railways:

- (1) Proper location of terminals, yards, and shop facilities.
- (2) Double or multiple-tracks.
- (3) Seasoned roadbed, good ballast, and heavy rail.
- (4) Light grades and curvature.
- (5) Adequate yards, sidings, spurs, and other tracks.
- (6) Bridges of sufficient strength and clearance for military loads.
- (7) Tunnels of sufficient clearance for military loads.
- (8) Loading and unloading facilities where needed.

- (9) Adequate refueling points.
- (10) Adequate signal system.
- (11) Gauge of track.
- (12) Length of line.

b. Adequate terminal facilities are vital. Terminal capacity may be increased by adding side tracks and vehicular roads to permit additional loading and unloading areas.

c. Maximum use of existing rail facilities and plants requires that cars be loaded and unloaded promptly.

4-4. Undesirable Characteristics

When railways are selected for military use, care must be taken to select lines that are least vulnerable to traffic interruption. Potential bottlenecks which are vulnerable to enemy action or natural forces are—

- a. Tunnels.
- b. Long, high bridges or bridges over deep streams or valleys.
- c. Deep cuts and high fills.
- d. Limited access terminals or yards.
- e. Track located immediately adjacent to banks of streams and dry washes subject to the erosive action of flood waters.
- f. Restrictive clearance points.
- g. Tracks running through cuts where land and rock slides are common.

4-5. Facilities

a. *Loading and Unloading.*

(1) For loading and unloading supplies and equipment, railways must have facilities, such as spur, house, team, and yard tracks; platforms; end and side loading ramps; cranes; hoists; and pumping facilities for loading and unloading liquids.

(2) Personnel, light vehicles, and light artillery may be loaded at most railway stations.

Other items, such as heavy trucks or equipment, may require special loading and unloading facilities.

(3) Points selected for loading and unloading should have easy access to adjacent highways and roads.

b. Entraining or Detraining Points. The terms entraining point and detraining point are used to designate the locations at which troops are to be loaded or unloaded. If required, sidings which normally are used for the passage of trains, main lines, or any other available facilities may be used to entrain or detrain personnel.

4-6. Use of Existing Facilities

a. Existing trackage and facilities are used to the fullest extent. Construction of new main track in the theater is avoided whenever possible. However, if required, new facilities are provided and existing facilities expanded to meet requirements. These facilities may include, but are not restricted to, yards, side-

tracks, fuel and water stations, signal systems (including telephone, telegraph, and radio means), and enginehouses.

b. As advances are made, captured enemy rail lines are rehabilitated as required. Availability for immediate service rather than permanency is the controlling factor in the type and character of rehabilitation.

c. The following general policies govern the construction or rehabilitation of facilities in the theater:

(1) *Yards and sidings.* Military necessity dictates the construction and/or rehabilitation requirement for these facilities, but existing track layouts of yards and sidings will be used as much as possible. Track surfaces, ties, and rail are accepted on a "good enough" basis when they meet the minimum requirement for safe operation.

(2) *Water and fuel stations.* Water and fuel stations consist of any suitable facilities which are available or which can be adapted or improvised.

CHAPTER 5

RELATIONSHIP WITH OTHER AGENCIES

5-1. General

a. Tact and cooperation are essential in all dealings between units and personnel of the transportation railway service and using agencies or military commands. In the field, railway groups and battalions are associated more closely with the users of transportation than is the transportation command. Because of this close association, railway units are able, through advice and assistance in solving transportation problems, to make the using units more knowledgeable of transport matters, thus affording a greater use of the rail transport capability.

b. Trains are operated by the transportation service. Operational safety prohibits interference by other personnel.

5-2. Higher Headquarters

a. The deployment of railway group headquarters and the railway battalions will be coordinated with the assistant chief of staff, movements, theater army support command, through the transportation command.

b. The highest railway commander in the theater advises the transportation railway service. Based upon this advice, the transportation command commander determines the quantity of materiel and personnel to be transported by rail. The railway commander reports conditions that affect the programmed movement of supplies, operating accomplishments, supply estimates, and plans for future courses of action.

5-3. Area Commands and Support Brigades

Transportation railway units are provided direct support services, in the army area, by the support brigades of the field army support command, and in the communications zone, by the area support groups of the area support command. Examples of this support include provision of clothing and rations, chemical and communications equipment, motor vehicle repair and supply, and personnel administration and accounting.

5-4. Combat Forces

The principal contact that the transportation railway service has with the combat forces is with these forces in their role as users of rail transportation. However, combat forces may be employed to provide security for trains and rail lines when requirements exceed the capability of organic, attached, and area support command units.

5-5. Other Services

The transportation railway service cooperates with and assists other services whenever possible. For instance, railway groups and battalions often assist the services in locating dump and depot sites and they locate rail sidings for hospital units to load and unload casualties. Although equipped primarily to repair standard railway equipment, the railway battalion may coordinate with other organizations in making emergency repairs to other equipment. The battalion also may assist in handling heavy lifts with its locomotive cranes.



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CHAPTER 6

RAILWAY MAINTENANCE AND SUPPLY

6-1. General

a. Transportation railway maintenance in a theater encompasses maintenance of rail lines and facilities and of locomotives and rolling stock. It ranges from rehabilitation of rail systems and major repairs on locomotives and rolling stock to minor repairs accomplished in units during daily inspections and services.

b. Transportation railway supply may be relatively complex since it may entail the support of not only standard U.S. Army equipment, but also foreign equipment used in support of military operations.

6-2. Maintenance of Way

a. *New Construction, Rehabilitation, and Major Repairs.*

(1) Although construction and rehabilitation of railway fixed facilities are the responsibility of the engineer command, the transportation railway service is responsible for maintaining both the right-of-way and the equipment used by railway battalions in the daily performance of their duties (TM 5-370, TM 5-627, and TM 55-204).

(2) In accordance with the overall theater plan and with instructions received through normal command channels, the transportation railway battalion makes the necessary reconnaissance and develops information for new construction and major maintenance projects. The battalion commander, the maintenance-of-way superintendent, and all railway personnel cooperate fully with the engineer command elements in all new construction and in any major maintenance projects on the military railroad. In some instances and under definite plans and arrangements, such work will be accomplished jointly by the engineer command and the transportation railway service.

b. *Organizational and Direct Support Maintenance.*

(1) After the railway is prepared and turned over to the transportation railway service for operation, organizational and direct support railway maintenance to the forward limit of traffic is the responsibility of the transportation railway service.

(2) The battalion commander has overall responsibility to insure that his division of the railway is maintained properly. The maintenance-of-way superintendent, who reports to the battalion commander, is directly responsible for maintenance of track and structures, for proper supervision of all maintenance work and procedures, and for necessary inspection of track and structures on the division operated by the battalion.

c. *Maintenance Standards.* The railway division operated and maintained by a battalion may consist of a newly constructed line or one that has been rehabilitated by the engineer command and turned over to the battalion, or it may be a line that sustained little or no war damage. Military traffic will be planned and operated to permit reaching line capacity as promptly as possible; this necessitates maximum maintenance effort. Command maintenance standards are specified by the engineer section of the headquarters and headquarters company of the senior railway unit. Major attention is required on tracks, bridges, and tunnels to prevent interruptions to train operations from maintenance failure.

d. *Materials.* Maintenance and emergency repair materials are stockpiled in adequate quantities at various strategic points along the rail line to be immediately available for emergencies.

e. *Roadway Maintenance.* Roadway maintenance is the work performed to keep that part

of the right-of-way on which track is constructed in good condition. This includes excavations, embankments, slopes, shoulders, ditches, and diversions of streams.

f. Track Maintenance. Track maintenance is the work performed to maintain the track in safe and operable condition. It includes inspection and repair to insure proper gage, alignment, and dress of the track. Constant inspection is required to locate damage resulting from hostile action or the elements.

g. Structural Maintenance.

(1) In a theater, structures essential to railway operation must be maintained in accordance with the standard of maintenance prescribed. These structures include bridges, culverts, tunnels, and fueling and watering facilities. Minimum clearances to be observed at all structures are prescribed by the Berne clearance system and other similar systems.

(2) Maintenance of structures involves maintenance of bridges including track fastenings; track alignment, gage, and surface; bridge ties, bolts, and guardrails; and bridge members such as floor stringers, beams, tie rods, and expansion bearings. Regular inspections are necessary to insure that bridges are kept in good condition at all times.

6-3. Maintenance of Motive Power and Rolling Stock

This paragraph discusses the maintenance responsibilities of the transportation railway service in the performance of organizational and direct support maintenance on locomotives, rolling stock, and special equipment and outlines briefly the maintenance responsibilities of the supply and maintenance command with respect to this equipment.

a. Maintenance of Motive Power. On motive power, maintenance by the railway service includes organizational and direct support maintenance services and periodic inspections. These inspections are as listed in the current reports of inspections and repairs, including those performed daily (or per trip), monthly, quarterly, and semiannually. Annual inspections are performed by units of the supply and maintenance command (TM 55-202).

b. Maintenance of Rolling Stock. The types

of maintenance services performed by railway service personnel on rolling stock are as follows:

(1) *Organizational maintenance.* Organizational maintenance is performed by operating units and by car inspectors at the train originating point and at inspection points en route to insure safe movement. It includes inspection of airbrakes, running gear, and other parts and examination and lubrication of journal boxes. On ambulance trains and cars, both before train departure and en route, ambulance train maintenance sections and crews are responsible for the following maintenance in addition to the above:

(a) Stocking of other than medical supplies, such as fuel, water, ice, and electrical supplies.

(b) Placing cars on, and removing cars from, standby precooling or heating facilities at loading or unloading points.

(c) Operating and controlling heating, air conditioning, and car lighting equipment.

(d) Replacing light bulbs and fuses.

(e) Checking batteries.

(f) Reporting all defects and failures.

(2) *Direct support maintenance.* Direct support maintenance is provided by the railway equipment maintenance company and the mobile workshop and consists of maintenance required for safe operation of freight equipment and safe and comfortable operation of passenger and hospital cars. It may or may not require that rolling stock be taken out of service.

(a) Operations that do not require removal of equipment from service and that are performed by car inspectors at the originating point of a train and at inspection points en route include the following: replacing brake-shoes; installing new airhose, adjusting brakes; applying journal brasses; repacking journal boxes; applying oil in journal boxes; and repairing draft gear, trucks, air conditioning, heating, or lighting equipment. Any of these services may be requested by the train conductor or train commander.

(b) Operations that require removal of equipment from service for short periods and that are performed by maintenance personnel

at home terminals or at maintenance facilities include changing defective wheels, journals, side frames, couplers, draft gear, and airbrake parts and repairing trucks, piping, and car bodies. In addition, on passenger equipment and hospital cars, such service includes daily, weekly, monthly, semiannual, and annual inspections; cleaning equipment; changing filters; deodorizing and cleaning evaporators; lubrication; repair to air conditioning, heating, and lighting equipment; charging batteries; maintaining water systems and coolers; and repairing and replacing hardware.

(3) *General support maintenance.* General support maintenance is provided by the diesel-electric locomotive repair company and the car repair company of the supply and maintenance command. In addition to supporting the maintenance overflow from direct support, general support maintenance includes heavy maintenance involving stripping, assembling, erecting, and painting railway cars and assembling and inspecting knocked-down new equipment brought into the theater.

c. *Maintenance of Special Equipment.* Maintenance of special equipment includes maintenance services and repairs performed on wreck train equipment, wreck cranes, and other cranes of the battalion; heavy roadway equipment; tools and enginehouse machinery; and other similar equipment.

d. *Maintenance of Captured Railway Equipment.* Captured railway equipment taken over for operation may have sustained extensive

damage or, because of operational pressure and a shortage of supplies, may be in a poor state of repair. Transportation railway personnel insure that all equipment taken over for operation is repaired and serviced before being placed in operation.

6-4. Railway Supply

a. Railway supplies are designated as technical supplies. Supplies required for operation and maintenance of railways are classified as follows:

- (1) Class III, operating fuels.
- (2) Class IV, roadway maintenance items.
- (3) Class VII, rolling stock end items.
- (4) Class IX, repair parts for rolling stock.

b. The railway car repair company of the supply and maintenance command is responsible for issuing repair parts for organizational and direct support maintenance of railway equipment.

c. The supply section of the senior railway unit in the theater is responsible for all classes of supply, including end items. Supplies are obtained from the supply and maintenance command through the appropriate depot.

d. Each railway unit is responsible for the storage of supplies issued. Normally, a railway battalion stores all materials for operation and maintenance of the one division (90 to 150 miles or 145 to 241 kilometers of main line) it is operating.



CHAPTER 7

RAILWAY CONSTRUCTION AND REHABILITATION

7-1. General

Although construction of new main track in a theater of operations is unusual, new construction may be required when rail facilities are nonexistent or inadequate. Since railway construction and/or rehabilitation are functions of the engineer command (theater army support command), transportation basic planning principles applicable to railway construction and rehabilitation are described in this chapter.

7-2. Responsibilities of the Engineer Command

a. The engineer command is responsible for construction, rehabilitation, and major maintenance of military railways. In addition, it is responsible for stockpiling material and equipment required to construct and/or rehabilitate the railway net.

b. In a theater the engineer command, when requested by the transportation command, prepares working plans and estimates and makes preliminary preparations for construction and/or rehabilitation of railways.

7-3. Responsibilities of the Railway Service

a. The railway service is responsible for planning and recommending to the transportation command the rail facilities that must be constructed and/or rehabilitated.

b. In a major construction or rehabilitation project, the transportation railway service provides technical advice and assistance and cooperates closely with engineer units. In addition, when directed, the railway service aids engineer units in accomplishing their assigned tasks.

7-4. Standards for Construction and Rehabilitation

a. Urgency of the tactical situation compels

construction standards to be much less exacting than for civilian railways. Safety factors will be lower. Sharper curves and steeper grades are permitted. Width of subgrade and depth of ballast may be less than for main line civilian railways. Initially, only minimum standards for operation have to be met. Improvement beyond initial requirements will be accomplished by the railway engineering company when the situation warrants such improvements.

b. Although engineer personnel prepare detailed railway construction plans, the transportation staff planner must consider the factors outlined in the following paragraphs of this chapter.

7-5. Main Line

a. Main line railways are an effective and expeditious form of transport in a theater of operations. When planning for employment, rehabilitation, and extension of a main line, the staff planner must determine the following:

- (1) Purpose and capacity.
- (2) Terminal points—initial, intermediate, final.
- (3) Direction of future development.
- (4) Controlling points as determined by tactical and strategic considerations.
- (5) Gage of tracks.
- (6) Maximum permissible degree of curvature.
- (7) Maximum permissible ruling grade.
- (8) Required distance between passing sidings.

b. Of the above elements, the ruling grade is the most important factor in the selection of a railway main line route. Natural drainage lines—rivers, inland waterways, shorelines,

etc.—provide the best and most regular gradients.

c. Essential requirements of a main line track are a stable, well-drained, and properly ballasted roadbed; and grades, curvature, and rail weights consistent with the weight and operating characteristics of available motive power and rolling stock.

7-6. Bridges and Tunnels

Construction of tunnels and long bridges should be avoided as much as possible since such construction requires large expenditures of time, material, and labor and these structures are exceedingly vulnerable to enemy action and sabotage.

a. When tunnels are required, they must have sufficient overhead and side clearance to permit the passage of the highest and widest load moving over the rail line.

b. When bridges must be constructed, stringers must be strong enough to support the heaviest load that will be transported over the rail line.

7-7. Passing Tracks

Based on the anticipated volume of traffic and train density, passing tracks must be located at intervals that will not restrict the end delivery tonnage requirement. These tracks generally are located 6 to 8 miles (10 to 13 kilometers) apart and must be long enough to contain the longest train that will be operated over the rail line. Sidings should be located so that turnouts will not be on curves and should, where possible, be parallel to the main track to facilitate signaling between head and rear members of train crews.

7-8. Yards, Terminals, and Railheads

Since yards, terminals, and railheads, are required to receive, classify, and make up trains, properly planned and located switching facilities are essential. There are many possible track arrangements. The design chosen should depend on the size and purpose of the yard and the size and topography of available sites. Terrain and traffic govern yard layouts to such an extent that there can be no standard yard, terminal, or railhead layout. In addition to facili-

ties necessary for repair of rolling stock and leading tracks adequate to permit continuous switching, most yards need only one arrangement of leading and parallel tracks.

7-9. Fuel and Water Stations

a. Fuel and water facilities should be located near the enginehouse at railway yards and/or terminals to permit servicing locomotives with a minimum of delay.

b. When steam locomotives are used in switching service, water facilities should be located at outlying points of the classification yard. If steam locomotives are used in road service, the distance between water stations along the main line should not exceed 30 miles (48 kilometers).

c. Fuel stations should be located at yards, terminals, and railheads. When steam locomotives are used in road service, no intermediate fuel stations are provided when the division is less than 85 miles (137 kilometers) long and one is provided when the division is 85 to 150 miles (120 to 241 kilometers) long.

7-10. Construction Effort

a. Railway construction requirements in terms of material and man-hours required for construction of new rail lines are set forth in paragraph 8-6, FM 101-10-1.

b. Comparison of new construction tables with rehabilitation tables in FM 101-10-1 shows the savings in material and manpower in rehabilitating rail lines rather than constructing new lines; for example, the requirement for new construction of a 100-mile (161-kilometer) division is 1,700,000 man-hours of labor and 58,000 tons of material, but rehabilitation of the same division requires only 635,200 man-hours and 26,827 tons of material.

7-11. Areas of Destruction

a. In past conflicts, railway destruction has been heaviest near ports of entry and lighter inland. Rehabilitation requirements are based on a percentage of demolition which is established by areas. Areas of destruction are defined in terms of miles based on World War II experience. Tables showing rehabilitation re-

quirement for each of the three following areas may be found in FM 101-10-1:

(1) Inland 0 to 30 miles (48 kilometers) from the coast—area of heavy destruction.

(2) Inland 30 to 100 miles (48 to 161 kilometers)—area of moderate destruction.

(3) Inland more than 100 miles (161 kilometers)—area of light destruction.

b. Past experience indicates that bridges, yards, and terminals suffer the greatest destruction.



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CHAPTER 8

RAILWAY ENGINEERING DATA

8-1. General

Existing railroad tracks and facilities in a theater of operations must be used to their fullest extent. New construction of port trackage, terminals, and other special needs of the railway service usually are all that can be undertaken in a theater of operations. Reconstruction or rehabilitation of large portions of existing railroad facilities must be anticipated following or concurrent with major advances. Good engineering judgment is necessary before and during railroad rehabilitation; therefore, some of the basic engineering data required in estimating capabilities of existing facilities are discussed in this chapter. These include curvature, gradelines, and bridge capacities.

8-2. Curvature

a. Curve Classification. The alinement of a railroad consists of straight sections (tangents) connected by curved sections. The sharpness of a curve is measured in degrees, minutes, and seconds. Curves are classified as simple, compound, and reverse. A simple curve is a single arc connecting two tangents. A compound curve is formed by two simple curves of different radii, both curving in the same direction. A reverse curve consists of two simple curves which bend in opposite directions. Figure 8-1 illustrates these three types of curves.

b. Degree Determination (Formula). American engineers use 100 feet (30 meters) as the invariable length of a unit chord for curve computations; however, it is possible to obtain an approximate value for the radius from the following simple empirical formula:

$$R = \frac{5,730}{D}$$

where

R = radius

D = degree of curvature

5,730 ft. (1,747 m) = approximate length of radius of a 1° curve

Likewise D can be obtained as follows:

$$D = \frac{5,730}{R}$$

c. Degree Determination (Approximate).

The string method may be used in the field to determine the approximate degree of curvature when a surveying instrument is not available. A portion well within the main body of the curve is selected, and a chord distance of 62 feet (18.9 meters) is measured along the inside of the high rail (points A and B, fig. 8-2). A string or strong cord is stretched tightly between points A and B, and the distance M is measured at the midpoint of the chord. This distance in inches is approximately equal to the degree of curvature. As a curve gets sharper, this distance increases.

d. Maximum Curvature. Although a straight line is the shortest distance between two points, if it results in too steep a grade or in numerous bridge and tunnel constructions, it is not the best location for a railroad line. Judicious and skillful use of curves offers the most satisfactory and, in many cases, the only means of locating track with grades, bridges, and tunnels held to a minimum. Table C-1 indicates the maximum curvature that locomotives used by the Department of the Army can traverse. When laying out new railroad locations, the planner should eliminate as many curves as possible, keeping those necessary for economical construction to an absolute minimum degree of curvature.

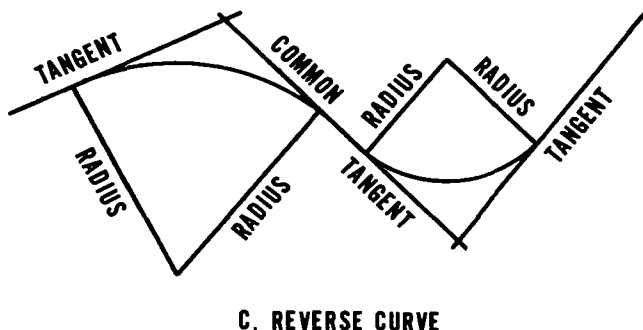
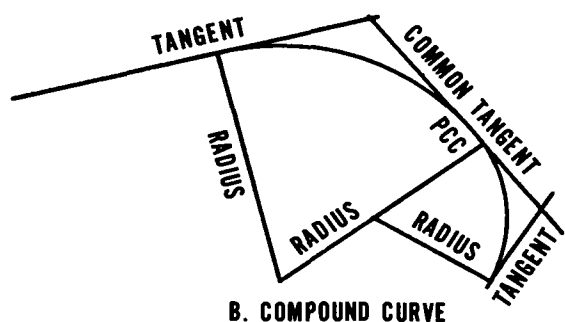
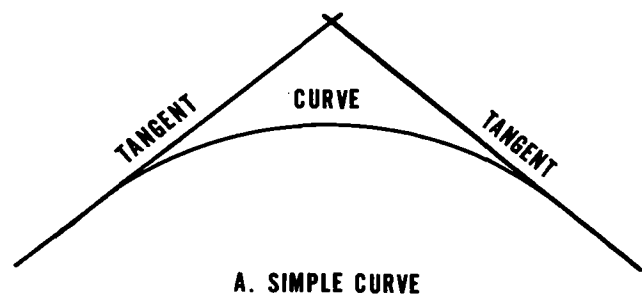


Figure 8-1. Curve classification.

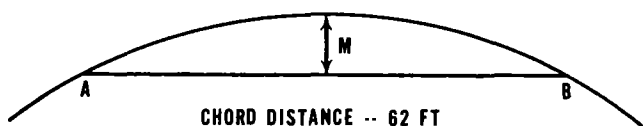


Figure 8-2. Degree determination using the chord system.

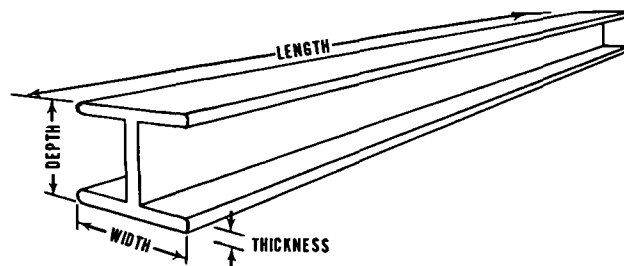


Figure 8-3. Measuring a steel stringer.

8-3. Gradelines

a. The planner should keep gradelines to a minimum because the maximum allowable grade generally is the deciding factor in selecting alignment; it limits the load a train may move over a division or line. Gradelines are designated by the vertical change in 100 feet (30 meters). A grade rising 2 feet in a horizontal distance of 100 feet is called a +2.0 percent grade; one descending the same amount is called a -2.0 percent grade. Any grade from 0.0 percent, or level to 0.4 percent is called light; from 0.4 to 1.0 percent, moderate; from 1.0 to 2.0 percent; and above 2.0 percent, very heavy.

b. Usually, on each division or at one location on the line, a grade occurs which sets the maximum tonnage that a given locomotive can pull; this is called the ruling grade. A short, steep grade may not be the ruling grade since tonnage trains may be longer than the grade and may be helped over the grade by the momentum of the train without any great reduction in speed. A long grade which requires the locomotive to pull the train over the entire grade and which has a gradeline that limits the tonnage that a given locomotive can pull is classed as the ruling grade of the particular division or line.

8-4. Bridge Capacity

a. *Bridge Loading.* Bridges are designed to carry safely a specific concentrated load. Loads which may be placed on a structure temporarily or which may be changed in position are termed live loads to distinguish them from fixed, dead, or static loads. Live loads are the tonnage trains; static loads are the superstruc-

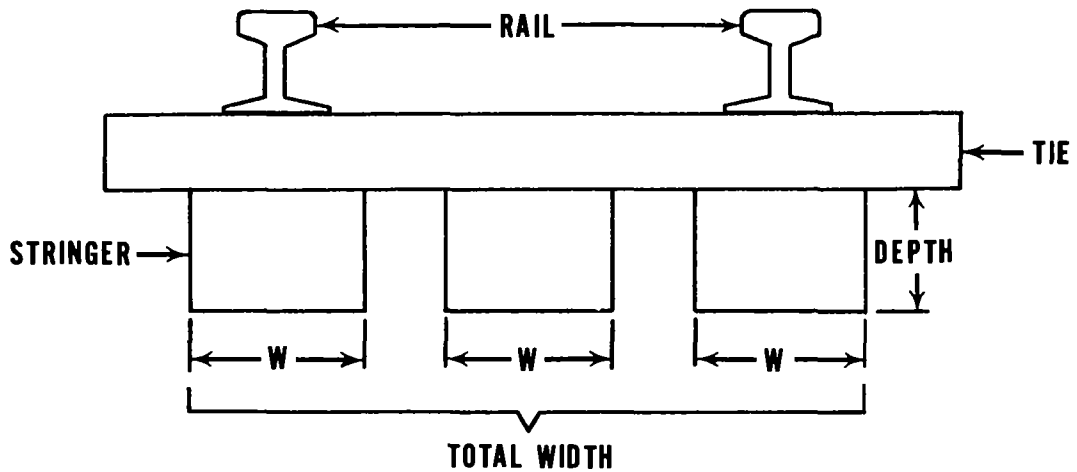


Figure 8-4. Measuring wooden stringers.

ture, tracks, ties, etc. The maximum line load, usually specified, consists of two coupled locomotives followed by the number of cars that occupy the entire length of the bridge. Various bridge loadings have been used, producing a great divergence in specifications and variable results. Of the innumerable loading formulas proposed, the only one which has had any standardized use is that proposed by Theodore Cooper in 1884. In this formula—known as Cooper's E rating—each driving axle on the locomotive carries a proportionate part of the total weight loaded on the drivers. The rating for a bridge to carry a 2-8-0 locomotive weighing 140,000 pounds (52,254 kilograms) on the drivers is determined as follows: A 2-8-0 locomotive has four driving axles; $140,000 \div 4 = 35,000$ pounds (52,254 kilograms $\div 4 = 13,064$ kilograms), the amount each driving axle will carry. A bridge designed to carry this locomotive safely must have a Cooper's rating of at least E-35 (the figure 35 denotes 35,000 pounds).

b. Steel and Wooden Stringer Bridges. There usually is an economical consistency in the design of all parts of a railroad bridge. Di-

mensions of the floor system are related to the load for which the whole structure was designed. Tables C-10 and C-11 show the Cooper's E rating of a number of typical railroad bridges and the dimensions of the stringers of their floor systems.

(1) *Steel.* To estimate the capacity of a railroad bridge with steel stringers or girders as part of the floor system, the width and thickness of the lower flange of the stringer are measured (fig. 8-3). The depth and the length of the stringer are also measured. The corresponding E rating of the bridge is then determined from table C-10.

(2) *Wood.* To estimate the capacity of a railroad bridge with wooden stringers as part of the floor system, the width of each stringer under one track is measured. The widths of all the stringers then are added together to obtain the total (fig. 8-4). The depth and length of one stringer also are measured. From table C-11, the wooden stringer is selected that most nearly approximates these dimensions and the corresponding E rating of the bridge is determined.



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CHAPTER 9

RAILWAY COMMUNICATIONS

9-1. Communications Responsibilities

a. The U.S. Army Strategic Communications Command (Theater) (FM 11-23) is responsible for reconstruction and rehabilitation of railway communications landlines. Although open wire cable is used as the primary means of communication for train operations, radio may be employed to provide backup facilities or as a primary means when construction and/or rehabilitation of landlines are not feasible.

b. The transportation railway service is responsible for—

(1) Operation and maintenance of railway communications circuits used exclusively for operation and administration of the transportation railway system, except for maintenance of automatic data processing equipment, which is a responsibility of the communications command.

(2) Installation, using TOE equipment, of organizational communications such as local switchboards, telephones, radios, and teletypewriters in yards, way stations, shops, and dispatches' offices for normal administrative and operational communications.

c. Installation, operation, and maintenance of organizational communications for administrative use are accomplished by the transportation railway battalion. The unit responsible for performing these functions for the battalion is the headquarters and headquarters company, transportation railway battalion.

9-2. Wire Communications System for Train Operation

The railway battalion employs open wire facilities as one of its primary means of communication to dispatch trains in the theater of operations.

a. Three communications circuits are provided for operations within each railway division: the dispatcher's circuit, the message circuit, and a teletypewriter circuit.

(1) The train dispatcher's circuit is used exclusively for train movements by train order and for control of trains through towermen and station agents within a division. It is a selective-ringing type voice circuit. The division dispatcher may call each way station independently or all stations simultaneously. The division dispatcher monitors the line at all times, using a loudspeaker or headset. Way station personnel may talk to the dispatcher on this circuit without signaling.

(2) The message circuit (station-to-station circuit) is used for block system operation within a division. It also is used for operational supervision and control, daily and special reports, car distribution, dissemination of movement orders to operating personnel, and operational matters between stations. This is a manual, local battery, code-ringing, party-line voice circuit. Way stations are connected to each other and to the division dispatcher. Any station may contact another station through code signaling.

(3) A teletypewriter circuit joins a division dispatcher with the adjacent division dispatcher. It is used for written transmission of train consists, operational orders, movement programs, general instructions, and miscellaneous messages. This circuit may be superimposed upon the message circuit.

b. The TOE for the headquarters and headquarters company of the transportation railway battalion (TOE 55-226) provides the terminal equipment for the communications system in support of the division dispatch office and the way stations of a railway division.

c. Figure 9-1 shows a type communication system for a railway battalion operating over a track distance of 100 miles (161 kilometers).

d. Since every rail installation is different, communications systems must be planned on a project basis. This requires close coordination between the transportation and signal staff elements far enough in advance to insure that the signal officer will have the necessary personnel and material on hand when required.

9-3. Signal Radio Communications System

Where communications landlines are inoperable, signal units, when authorized by the theater army commander, will provide radio relay or other supplementary communications as required. Teams from TOE 11-500 are attached to the railway battalion for the installation, operation, and maintenance of this system.

9-4. Organizational Radio Communications

Mobile and fixed radio communications increase efficiency, control, coordination, and safety of train movements. Radio equipment is organic to railway operating units, and its use is a normal part of rail operations. Radio communications will be employed in yard, main track, and other operations and between the locomotive and caboose of moving trains.

a. *Yard Operation.* The use of radio communication in yard operation has the following advantages:

(1) Yard crews can notify the yardmaster upon completion of assignments and receive new assignments immediately.

(2) Delays at the interlocking plant can be eliminated by knowledge of train location.

(3) Special movements, such as hospital trains, can be expedited.

(4) Delays caused by derailment or damage to cars or cargo can be reported immediately.

(5) Arrival time can be determined more accurately through communication with incoming trains.

(6) Changes in train movements or orders can be disseminated rapidly.

b. *Main Track Operation.* Radio communication equipment mounted in road engines and in way stations extends communications from the

way station to the moving train. This is not intended to take the place of any communications system for which signal units are responsible on a planned project basis. Main track radio communications afford contact between trains and the dispatcher, between trains and way stations, and between stations. Use of this equipment has the following advantages:

(1) In an emergency, the train engineer can call the way station operator and, if the train has to stop, other trains within range of the radio frequency can be advised to take necessary precautions.

(2) Train speeds can be regulated to insure proper meetings at passing points.

(3) Derailments can be reported immediately and repair crews can be dispatched quickly.

(4) Crossing accidents can be reported and military police and medical assistance can be expedited.

(5) Train crews can request fuel or other supplies before arrival, thus reducing time at stops.

(6) The train engineer can be informed of the condition of the tracks as a result of snow and rock slides, flash floods, and bridge wash-outs.

(7) Guerrilla operations, sabotage attempts, and air attacks can be reported promptly by train crews.

c. *Organizational Radio Equipment.* Requirements for radio communication equipment authorized by TOE are based on the fact that an average railway division is approximately 90-150 miles (145-241 kilometers) long, that it consists of approximately two large terminals or yards, and that it contains nine way stations spaced approximately 10-15 miles (16-24 kilometers) apart. In actual operations, the requirements for radio sets may vary, depending upon the tactical situation, the terrain, the facilities available, and the local circumstances. The types of organizational radio equipment available are as follows:

(1) *Radio sets AN/RRC().* These sets are installed on road locomotives to enable the locomotive engineers and the way station operators to communicate with each other. Communication is possible between the yardmaster

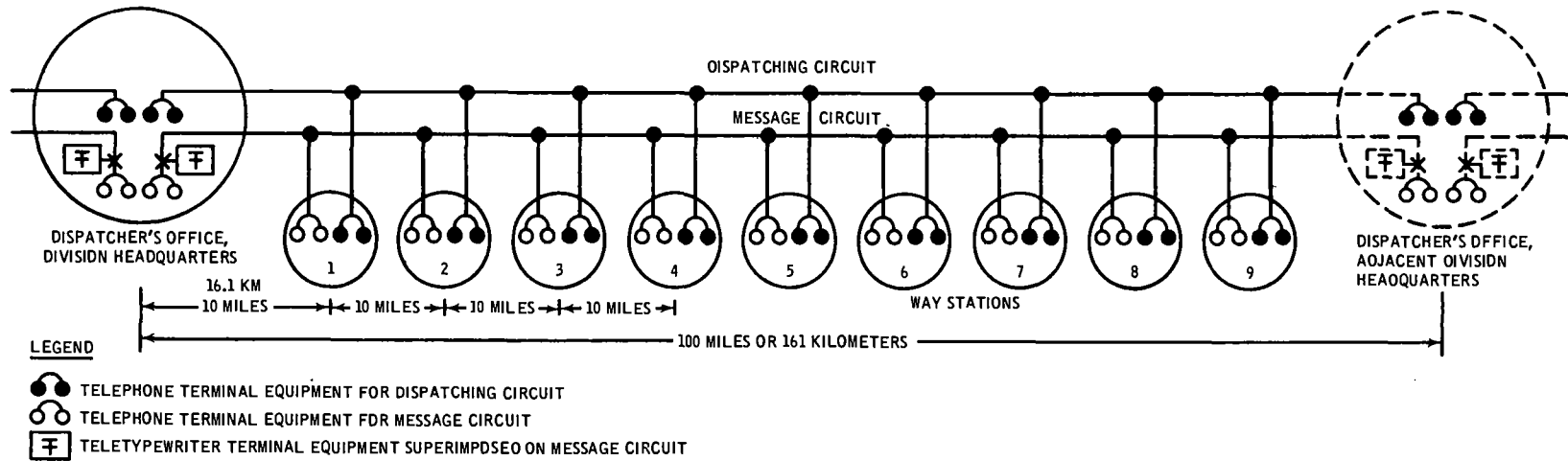


Figure 9-1. Military railway communications system.

and the engineer of a train approaching a yard. These sets also are mounted in switch engines to permit communication between the switch engine crew and the yardmaster for coordination of yard operations. Since the radio operates on 72- or 32-volt direct current, an adapting device is required when the set is installed and operated in road or yard locomotives.

(2) *Radio sets AN/TRC()*.

(a) Since open wire communication terminates at the way station, radio equipment must be provided for communication with a moving train between two stations. With radio-equipped engines and radio sets in way stations, this means is provided. This system extends communications to the train crew and provides the train engineer with a means of contact with the dispatcher at all times.

(b) The AN/TRC() is a transportable communications facility used at a wayside station not only for control of train movements, but also to provide communications between stations. This facility has the capability of a

repeater network in the event of sabotage of landlines or the nonavailability of landlines. It is provided with a power unit to extend the flexibility for installation in remote areas. This station can be unattended if no traffic is generated at the station.

d. *Train Control—Dispatcher*. The following equipment is installed in the dispatcher's office for train control:

(1) Radio AN/GRC(): used as base station to provide communications between trains and dispatcher.

(2) Centralized radio control: to control and extend range of communications between dispatcher, waystation, and trains.

(3) Control unit C-(): used by dispatcher for selecting mode operation.

(4) Telephone HC-500.

(5) Selector station SA-(): selective station calling device.

(6) Bell BZ-().

(7) Audiotelephone: TA-().

(8) Radio control C-(): used with radio base station.

CHAPTER 10

RAILWAY AUTOMATIC DATA PROCESSING SYSTEM

10-1. General

If an automatic data processing system is to be used in a theater and if the system is available, it will be employed by the railway service. The type of automatic data processing system used is of small importance to the railway operators so long as it is responsive to the railroad's needs. However, the communications system must be capable of providing an uninterrupted service on a 24-hour-per-day basis. The failure of the communications system to provide this service will destroy its value for railway operations completely.

10-2. Automatic Data Processing System Requirements

a. A railway service involving operation of two railway systems will encompass over 2,000 miles (3,219 kilometers) of track. It is necessary to maintain accurate, up-to-the-minute location and movement information covering over 15,000 railway cars. It also is necessary to inform shippers and receivers of the location of their consignments immediately upon receipt of their inquiries at the computer center. Combined random access to this information is required so that it will be available for re-

peated use, eliminating duplicate provision of source information.

b. The flow of information starts with the punching of waybill information into cards at the various points of train organization. This information then is transmitted through the data terminals to the computer, entered into the disk-pack files (giving a random access capability), and simultaneously transcribed to magnetic tape. Additional information is transmitted from the freight terminals to the computer when the train starts moving. This action will complete the information needed to answer car location inquiries.

c. The automatic data processing system also may be used in other processing functions such as—

- (1) Production of advance train consists.
- (2) Perpetual yard inventory.
- (3) Centralized freight agency accounting and cost accounting with allied nations.
- (4) Computation and development of locomotive and car statistics.
- (5) Passing reports.
- (6) Computation of right-of-way and structures statistics.
- (7) Scheduling of trains.
- (8) Routing of trains.



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CHAPTER 11

RAILWAY SECURITY

(STANAG 2113)

11-1. General

a. In the theater, security of military and Government-sponsored supplies and equipment is of extreme importance and necessitates the use of military personnel in addition to security provided by a host government. To insure an integrated security effort, security elements attached to the transportation railway service maintain liaison and coordination with security units having area responsibility.

b. Military action causes much destruction and confusion in cities and ports and along lines of communication. Railways are especially vulnerable in such areas. Further, military operations require logistical support that often exceeds the normal capacity of the existing ports, lines of communications, and supply support. These demands necessitate the use of temporary and improvised facilities, thus increasing the problems of safeguarding cargo, equipment, and installations against vandalism and pilferage.

c. Guerrilla activities, sabotage, and hostile air action further add to the loss of cargo and railway equipment and to the degree of vigilance required. In aggravated situations guerrilla activities may cause significant interruptions, and defense against such activities may require extensive security measures in order to continue operations.

11-2. Responsibility for Security

a. *General.* Protection of Government property is the responsibility of every officer and enlisted man in the Military Establishment. Combat and communications zone commanders are responsible for the security of their areas, including defense against enemy air or

ground attack and against sabotage of lines of communication, installations, and Government property.

b. *Military Police Units.*

(1) Military police battalions, railway guard, are attached to the transportation command on the basis of one battalion for each transportation railway group. Military police companies are assigned to the military police battalion on the basis of one company for each transportation railway battalion. Normally, the companies remain under command of the military police battalion and provide guard service to the railway battalion.

(2) Additional security support may be made available to the railway service by the area support command.

(3) Military police officers are provided on the staff of the senior railway service unit to advise and recommend on military police and physical security matters.

11-3. Security of Supplies Moving by Rail

a. The transportation railway service security responsibility for supplies, mail, and other cargo moving by rail begins when the loaded cars are accepted from the shipper and ends when these cars are delivered to the ultimate consignee.

b. An essential element in providing adequate security for railway shipments is a competent system of documentation and records; in addition, proper loading and sealing of cars and prompt loading and unloading aid materially in reducing pilferage.

c. Military police units attached to the transportation railway service provide train guards for cars and trains en route and for cars and

trains in movement in rail yards. When cars requiring repair are set out, a member of the guard crew remains with the cars to protect the cargo from pilferage until properly relieved. Guard crews check car seals and documentation and must be particularly alert for damaged or inferior cars that are subject to pilferage. Train guard reports indicate deficiencies or action taken and are used as a basis for coordinated action by the military police and the transportation railway service.

d. FM 101-40 establishes the requirement for a technical safety escort of hazardous chemical and biological shipments. This function is performed by a munitions safety control detachment whose duties include escorting and guarding shipments in transit, protecting personnel handling the shipment, disposing of damaged munitions, and decontaminating objects and areas accidentally contaminated during shipment. Close coordination between the safety control detachment and transportation railway service personnel is maintained at all times.

11-4. Security of Railway Installations

Security of static installations, such as buildings, tunnels, bridges, yards, and shops, against enemy air or ground attack and sabotage must be provided for in local security and damage control plans.

11-5. Security of Trains Against Enemy Ground or Air Attack

a. *Ground Attack or Guerrilla Warfare.* It may be necessary to operate and maintain rail lines in areas subject to guerrilla activity or where pockets of resistance have been bypassed during rapid advances. In such situations, any of the following actions may be necessary:

(1) Armored trains may be used to patrol track in open country. Since the mission of these trains differs from that of regular trains, a dual responsibility for their operation exists: the trains operate under orders of the appropriate military commander in coordination with the transportation railway service. The commander responsible for furnishing security provides the security personnel to man weapons

and provides a striking or retaliatory force. The transportation railway service is responsible for technical operation of the trains and provides specially selected crews to insure instant response in a tactical situation. The movement of armored trains must be coordinated with other train movements, and their movement in response to a tactical need must be facilitated.

(2) Various methods may be used to prepare cars for railway defense; among these are piling sandbags on floors and against the sides, and mounting machineguns, mortars, rocket launchers, and other weapons in the cars.

(3) The use of fixed or rotary wing aircraft for aerial reconnaissance and patrols along a rail line provides additional security measures. These aircraft also may be employed to provide close fire support for armored trains.

(4) On a single-track rail division subject to ground attack, the positive block method of operation should be employed. In this method of operation, a following train is not permitted to enter a block until the preceding train has cleared that block. This permits the train in the block, if attacked, to back up if necessary.

(5) The primary mission of train personnel and combat or security troops is to get the train through to destination. As long as this mission is being accomplished and the train continues to move, control of the train remains with the train crew. However, if a firefight develops and the train is unable to disengage by forward or backward movement, the senior member present takes command and undertakes defense of the train with all personnel available.

b. *Enemy Air Attack.*

(1) Defense against air action is conducted by security force units supporting the train. Antiaircraft weapons are provided on cars spaced throughout the train as required.

(2) Trains that are attacked by aircraft should continue to move, if possible; however, when visibility is poor and the physical characteristics of the rail lines are favorable, it may be possible to conceal trains in tunnels, deep cuts, or heavily wooded areas.

(3) Measures taken by train operating

personnel for protection against chemical agents delivered by aircraft include wearing protective clothing and masks; employing chemical agent detector kits to check locomotives, rolling stock, and cargo transported in open cars for contamination; and performing decontamination within their capability.

1-1-6. Employment of Non-Air Defense Weapons Against Aircraft

a. General. Commanders at all levels must recognize that not only do the trains, equipment, and railroad facilities of the transportation railway service offer favorable targets for hostile aircraft, but also that there exists the threat of airmobile operations, enemy close air support, interdiction, and reconnaissance against any unit in a theater of operations. They must recognize further the potential effect of the large volume of small arms fire that can be furnished by organic weapons against low-flying aircraft and the fact that the low altitude air threat faced by units in the combat theater may be countered partially by aggressive use of the large volume of fire which non-air defense weapons can deliver.

(1) Exercise of the individual and collective right of self-defense against hostile aircraft, which includes all attacking aircraft and those positively identified enemy aircraft that pose a threat to the unit, will be emphasized. Exercise of this right does not demand specialized use of communications and is independent of theater air defense rules for engagement and air defense control procedures.

(2) Indiscriminate use of non-air defense weapons must be prevented because of the danger to friendly aircraft and troops and of the requirement to place in proper perspective the technique of withholding fire to preclude disclosure of position.

(3) Situations may arise where the exercise of the right of self defense should be suppressed temporarily or where the freer use of non-air defense weapons against aircraft should be encouraged. Since the former case involves a local decision that prevention of position disclosure is paramount, notice of such restriction is disseminated through command

channels. The latter case should be based on a theater-level decision.

(4) Use of single rule for engagement, "Engage hostile aircraft," is based on the knowledge that common-sense interpretation of the rule will be correct. For example, any aircraft attacking a unit or any enemy aircraft performing operations such as forward air control, reconnaissance, surveillance, or dropping or landing troops are clearly hostile aircraft.

b. Rule for Engagement. In the absence of orders to the contrary, individual weapons operators will engage attacking aircraft; engagement of all other hostile aircraft will be on orders issued through the unit chain of command and will be supervised by unit leaders. Nothing in this rule is to be interpreted as requiring actions prejudicial to accomplishment of the primary mission of the unit.

c. Aircraft Categories. To simplify engagement procedures, aircraft are divided into two categories:

(1) *Low-speed aircraft.* This category includes helicopters and liaison, reconnaissance, and observation fixed-wing propellor aircraft.

(2) *High-speed aircraft.* This category includes all other propellor aircraft and all jet fixed-wing aircraft.

d. Techniques of Fire. The following techniques will maximize the destructive and/or deterrent effect against aircraft:

(1) *Engagement of low-speed aircraft.* In accordance with the rule for engagement, low-speed aircraft will be engaged with aimed fire, employing maximum weapon rate of fire. Aerial gunnery techniques generally applicable to all small arms and automatic weapons are contained in FM 23-65.

(2) *Engagement of high-speed aircraft.* In accordance with the rule of engagement, high-speed aircraft will be engaged with maximum fire aimed well in front of the aircraft and above its flight path to force it to fly through a pattern of fire. This technique is not unaimed barrage fire but requires a degree of aimed fire. It does not, however, call for careful estimation of aircraft speed and required lead.

(3) *Use of tracer ammunition.* Automatic weapons should use the highest practical proportion of tracer ammunition to enhance the deterrent or disruptive effect of fire.

(4) *Massed fire.* Units should employ a massed fire technique when using small arms and automatic weapons in an air defense role.

e. Standing Operating Procedures (SOP). Command and supervisory headquarters will prepare detailed SOP for the identification and engagement of aircraft, to include how identification is accomplished, weapons to be employed, techniques of fire to be used, rule for engagement, and controls to be exercised. Company-level SOP will include but is not limited to—

(1) *Applicability.* The SOP applies to operators of designated weapons.

(2) *Relation to primary mission.* Primary mission is never prejudiced.

(3) *Relation to passive air defense.* The necessity for aggressively engaging hostile aircraft is balanced against the requirement to place in proper perspective the tactic of withholding fire to preclude disclosing position.

(4) *Authority to engage.* Authority to engage attacking aircraft is delegated to individual weapons operators. All other hostile aircraft are engaged on orders through unit chain of command, subject to rule for engagement and rules for withholding fire.

(5) *Rule for engagement.* Engagement normally will be in self-defense only against all attacking aircraft and those positively identified aircraft which pose a threat to the unit.

(6) *Rules for withholding fire.* Fire will be withheld when ordered, when it is not certain that aircraft actually are attacking or otherwise hostile, and when friendly aircraft or troops are endangered.

(7) *Position selection (FM 44-1).* This is applicable only to weapons specifically assigned an air-defense role; for example, designated single-barrel, 50-caliber machineguns.

(8) *Firing techniques.* Firing techniques include lead and super-elevation, massed fire, maximum rate of fire, and maximum use of tracer ammunition.

(9) *Unit training requirements.* Unit training includes motivation and discipline, gunnery, and aircraft recognition.

f. Individual Training. Individual training stresses aircraft recognition, techniques of firing at aerial targets, and response to control methods.

11-7. Demolition Plans

a. The extent of demolition of rail equipment and facilities is based on the commander's estimate of the situation and is of two types:

(1) Total destruction of locomotives, rolling stock, track, structures, and facilities is undertaken when the situation is such that the facilities and equipment will be of no further use and the territory being lost is not expected to be recovered for an extended period of time.

(2) When it is anticipated that lost territory will be regained in a relatively short time, immobilization of equipment and facilities by removing and saving essential and similar parts of locomotives and rolling stock and partially demolishing selected bridges or tunnels temporarily will deny the use of tracks, equipment, and facilities to the enemy. The fact that the enemy may completely destroy the equipment and facilities upon his retreat is a calculated risk, which must be accepted.

b. All units of the transportation railway service will maintain current demolition plans for each class of demolition to indicate the following:

(1) Company and unit teams responsible for implementing demolition plans.

(2) Quantities of demolition materials required and locations at which stored.

(3) Plan to implement demolition.

(4) Demolition procedures (STANAG 2113, app G).

c. Demolition and alert plans will be consolidated by the railway group or railway brigade and coordinated with the transportation command or the commander designated to order implementation of the demolition plans.

d. Destruction of ambulance trains or cars is governed by the law of land warfare as stated in FM 27-10, which contains the provisions of the Geneva Convention of 12 August 1949.

CHAPTER 12

PLANNING

Section I. GENERAL

12-1. Planning Considerations

The overall staff and planning functions of the transportation railway service are the responsibility of the commander of the highest echelon of the transportation railway service unit in a theater. Planning is necessary for effective use of rail transportation facilities in any given area. For effective and efficient planning, essential information should be available concerning the basic characteristics of the line to be operated and the nature of the country in which an operation is planned. By combining this information with basic assumptions, estimates can be made of railway capacity and of requirements for personnel, supplies, and equipment needed to operate the line.

12-2. Conditions Affecting Planning

a. The transportation railway service initially operates and uses existing rail lines, equipment, and facilities available in a theater. Only that equipment and construction material necessary to support military operations is brought into the theater to supplement existing facilities.

b. Operating conditions affecting military railways may vary widely. The problems presented by one short single-track railway will be quite different from those presented by a network of railway tracks. Therefore, instructions and information contained in this text are stated in general terms.

Section II. RAILWAY LINE CAPACITY DETERMINATION

12-3. General

a. Since the direction of military supply movements is primarily forward, military rail line capacity estimates generally are based on net tonnage moved in one direction. However, total capacity of a rail line is based on train density and must take into consideration movements of trains in both directions. When the railway net under consideration is composed of several divisions and branch lines, separate estimates should be made for each rail division and branch line.

b. In estimating railway line capacity in terms of payload hauled, limiting factors are the power of the locomotive and the resistances offered by the grade, the curve, the locomotive, the cars, the lading, and the weather.

c. The formulas and factors presented in the following paragraphs of this section are listed

in the order in which they should be considered. Appendix B is an illustrative example giving step-by-step procedures for determining rail line capacity. Tables C-1 through C-9, Appendix C, contain many of the factors to be considered.

12-4. Weight on Drivers

Weight on drivers is expressed in short tons and is that weight which is supported by the coupled driving wheels of a locomotive when they rest on straight, level track. It does not include any of the remaining portion of the locomotive's weight. The weight on drivers of some locomotives used by the Department of the Army is shown in table C-1; for those not listed in this table, specifications issued by the purchaser, the using railroad, or the manufacturer must be consulted.

12-5. Tractive Effort

Tractive effort is a measure of the potential power of a locomotive expressed in pounds; it is the horizontal force that a locomotive can exert on straight, level track, provided the wheels do not slip. A locomotive's tractive effort is included in the data supplied by the manufacturer. The tractive effort of some locomotives used by the Department of the Army is contained in table C-1. Where such data are not available, tractive effort may be determined as indicated in *a* and *b* below.

a. Starting Tractive Effort (TE).

(1) Starting tractive effort is the power that a locomotive can exert to move itself and the load that it is hauling from a dead stop. It is correlated closely to the adhesion which the driving wheels maintain at the rails. If the tractive effort expended exceeds this adhesion factor, the driving wheels will slip. Normally, the adhesion factor when the rails are dry is 30 percent of the weight on drivers; when the rails are wet, this factor is reduced to 20 percent. For planning purposes, 25 percent is used.

(2) For a diesel locomotive weighing 80 short tons (73 metric tons) or 160,000 pounds (72,574 kilograms) on the driving wheels, the starting tractive effort is computed as follows:

$$\begin{aligned} TE &= \frac{\text{weight on drivers (lb (kg))}}{25\% \text{ adhesion factor}} \\ &= \frac{160,000 \text{ lb (72,574 kg)}}{4} \\ &= 40,000 \text{ lb (18,136 kg)} \end{aligned}$$

b. Continuous Tractive Effort (TE_c). Continuous tractive effort is the effort required to keep a train rolling after it has been started. As the momentum of a train increases, the tractive effort necessary to keep the train moving diminishes rapidly. Since a diesel-electric locomotive cannot continue to exert the same force while pulling a load as was attained in starting that load, the continuous tractive effort of a diesel-electric locomotive is rated as approximately 50 percent of its starting tractive effort. For a diesel-electric locomotive weighing 80 short tons (73 metric tons) or 160,000 pounds (72,574 kilograms) on the

driving wheels, the continuous tractive effort is computed as follows:

$$\begin{aligned} TE_c &= \frac{TE}{2} \\ &= \frac{40,000 \text{ lb (18,136 kg)}}{2} \\ &= 20,000 \text{ lb (9,068 kg)} \end{aligned}$$

12-6. Drawbar Pull (DBP)

a. Drawbar pull, in terms of pounds per ton, is required to start the average locomotive or freight car on straight, level track under favorable weather and temperature conditions. For railway planning, 20 pounds per ton is used. Resistance drops after equipment starts rolling, but to establish pulling power (drawbar pull) available for starting and pulling a train, 20 pounds per ton of locomotive weight is subtracted from the continuous tractive effort of the locomotive. For a diesel-electric locomotive weighing 80 tons and having a continuous tractive effort of 20,000 pounds, the drawbar pull is computed as:

$$\begin{aligned} DBP &= TE_c - (\text{total weight of engine in} \\ &\quad \text{STON} \times 20 \text{ lb per STON}) \\ &= 20,000 - (80 \times 20) \\ &= 20,000 - 1,600 \\ &= 18,400 \text{ lb (8,346 kg)} \end{aligned}$$

b. Maximum drawbar pull can be exerted only at lowest speeds—up to about 10 miles (16 kilometers) per hour; at higher speeds diesel-electric locomotive drawbar pull diminishes rapidly.

12-7. Rolling Resistance (RR)

The force components acting on a train in a direction parallel with the track which tend to hold or retard the train's movement constitute rolling resistance. The components of rolling resistance are friction between the railheads and the treads and flanges on the wheels, resistance due to undulation of track under a moving train, internal friction of rolling stock, and resistance in still air. There is no absolute figure to be used as rolling resistance, but experience indicates that safe average values to

use in the theater of operations for rolling resistance are as shown in table C-2.

12-8. Grade Resistance (GR)

Grade resistance is the resistance offered by a grade to the progress of a train. It is caused by the action of gravity, which tends to pull the train downhill. For military railway planning, the factor of 20 pounds per ton of train per percent of grade is used.

12-9. Curve Resistance (CR)

Curve resistance is the resistance offered by a curve to the progress of a train. No entirely satisfactory theoretical discussion of curve resistance has been published; however, engineers in the United States usually allow from 0.8 to 1 pound per ton of train per degree of curve. In military railway planning, the factor of 0.8 pound per ton of train per degree of curve is used.

12-10. Weather Factor (W)

a. The weather factor reflects, by percentage, the adverse effect of cold and wet weather on the hauling power on a locomotive. Experience and tests have proved that, whenever the outside temperature drops below 32° F, the hauling power of a locomotive is decreased. Table C-3 indicates the weather factor (percent) for varying degrees of temperature.

b. Ordinarily, wet weather is regarded as local and temporary and is considered absorbed by average figures. However, in countries having extended wet seasons (monsoons, fog, etc), the loss of tractive effort due to slippery rails may prove serious if sanding facilities are lacking or inadequate. The applicable reduction is a matter of judgment, but in general tractive effort will not be reduced to less than 20 percent of the weight on drivers.

12-11. Gross Trailing Load (GTL)

a. Gross trailing load is the maximum weight or load in short tons that a diesel locomotive may safely pull behind it under given conditions of curvature and grade on a level track. It is determined by combining the factors discussed in paragraphs 12-6 through

12-10. The formula for gross trailing load is as follows:

$$GTL = \frac{DPB \times W}{RR + GR + CR}$$

where

GTL = gross trailing load

DPB = drawbar pull

W = weather resistance

RR = rolling resistance

GR = grade resistance

CR = curve resistance

b. When multiple unit diesel locomotives or pushers are used, the gross trailing load is equal to the sum of the gross trailing load for all locomotives used.

c. For foreign or captured locomotives for which little or no information is available, the gross trailing load is obtained by actual test as quickly as track and cars become available.

12-12. Net Trainload (NTL)

Net trainload is the payload carried by the train. The total weight of the cars under load is gross weight; the lightweight, or weight of the cars empty, is tare. The difference between these two is the net trainload (payload) of the train. For military railway planning purposes, the net trainload is 50 percent of the gross trailing load.

$$NTL = GTL \times .50$$

12-13. Train Density (TD)

a. General.

(1) The term train density is used to denote the number of trains that may be operated safely over a division in each direction during a 24-hour period. Work trains are not included in computing train density. However, their presence on divisions and the amount of time they block the main track can reduce the density of a rail division. Train density may vary greatly over various division owing to the condition and length of the main line; number and locations of passing tracks; yard and terminal facilities; train movement control facilities and procedures; and availability of traincrews, motive power, and rolling stock.

(2) On single track lines, passing tracks

generally are 6 to 8 miles (10 to 13 kilometers) apart. Multiple tracks (three or more) generally are considered as double track since it often is necessary to remove a portion or all of the third and fourth tracks to maintain a double track line.

(3) The capacity or operating turnover of cars and trains into and out of terminal yards must be considered, either from definite experience and intelligence factors or by inference from related information.

(4) The rule-of-thumb and the formula given in *b* and *c* below are designed primarily to determine freight train density; however, they will be reasonably accurate on lines over which passenger trains do not exceed 20 percent of the traffic.

b. Rule-of-Thumb for Determining Train Density. In the absence of sufficient intelligence upon which to evaluate the potential train density of a rail line, a train density of 10 for single track and 30 for double track is used for planning.

c. Formula for Determining Single Track Train Density. When sufficient intelligence is available, the following formula and factors may be used in determining train density for a specified railway division. In determining the number of passing tracks, those less than 5 miles apart should not be included. Passing tracks selected generally should be uniformly spaced throughout the division.

$$TD = \frac{NT + 1}{2} \times \frac{24 \times S}{LD}$$

where

TD = train density

- NA* = number of passing tracks
- 1 = constant (number of trains that could be run if there were no passing tracks)
- 2 = constant to convert to one direction
- 24 = constant (number of hours per day)
- S* = average speed (table C-4)
- LD* = length of division

When the computation for train density results in a fraction, the result is raised to the next higher whole number.

12-14. Net Divisional Tonnage (NDT)

Net division tonnage is the tonnage in short tons, or payload, which can be moved over a railway division each day. It includes railway operating supplies, which must be programmed for movement the same as any other supplies. Net division tonnage is determined by multiplying the net trainload by the train density of the particular division:

$$NDT = NTL \times TD$$

Net division tonnage is computed separately for each division.

12-15. End Delivery Tonnage (EDT)

In military operations, the end delivery tonnage is the through tonnage, in short tons, of payload that may be delivered at the end of the railway line (railhead) each day. In an all-rail movement, the end delivery tonnage is the same as the net division tonnage of the most restrictive division.

$$EDT = NDT \text{ of most restrictive division}$$

Section III. RAILWAY YARD CAPACITY DETERMINATION

12-16. General

a. Railway yards, like other component elements of a railway, are designed to meet the requirements of normal operations of the area they serve. However, they may be required, within reasonable limits, to handle a traffic load varying from average peacetime traffic to peak wartime traffic requirements, but efficiency of operation may decrease when the traffic exceeds the efficient operational capacity of the yards.

b. Railway yard operational capacity has a definite relation to the number of trains that can be forwarded to or received from the main lines. Thus, although the potential train density of a main line may be 30 trains per day, the actual or operating train density may be less because of limitations of the yards.

c. Railway terminals may include the following:

- (1) Receiving yards.
- (2) Classification yards.

(3) Forwarding yards.

(4) Other yards such as holding, repair, interchange, and storage yards.

d. In railway operations, during peak traffic requirements, the classification yard is most likely to become the bottleneck since there are many variables which will affect the number of cars per hour that may be switched.

e. See paragraph 3-6 for additional information on types of yards.

12-17. Planning Factors for Classification Yards

The factors listed below are based on day and night operation and may be used for planning purposes. Where two or more main line railways intersect at a major terminal, the facilities will have to be duplicated accordingly.

a. Flat switching capacity is 30 cars per locomotive per hour. This includes time for switch engines to push cars into the yard (based on foreign equipment).

b. Hump switching capacity is 45 cars per locomotive per hour.

c. The number of cars in a classification yard at any given time should not exceed 60 percent of the yard's capacity. When it exceeds this figure, switching room lessens and operating efficiency is sacrificed.

d. A typical breakdown of classifications tracks required for loaded cars could be as follows: two each for class I, II, III, IV, V, VI, VII, IX, and X supplies; one for class VIII supplies; and two for empties. In heavy traffic areas, an additional track factor of 25 percent may be added for rotation.

e. Length of track in a classification yard generally is one train length, plus 20 percent, plus 300 feet (91 meters). The length of tracks and/or trains varies with local terrain characteristics, railway equipment, and requirements.

f. The number of switch engines per shift that may be employed in the operation of the loaded freight classification yard may vary from one to three, depending on the yard layout. Thus, one switch engine may handle 30 to 60 cars per hour and three switch engines may handle 90 to 180 cars per hour.

(1) The breakdown of functions would be as follows:

(a) One switch engine at the head end of the receiving yard preparing cut of cars for switching.

(b) One switch engine switching cut of cars into the classification yard.

(c) One switch engine at the opposite end of the classification yard coupling cars and making switching room.

(2) During slack traffic periods, one switch engine may be used for all the above functions.

(3) It must be understood that the switch engine requirements being discussed are for use in the classification yard proper and do not include those engaged in supporting other terminal operations.

g. The average time a car remains in the classification yard is 8 hours.

h. Classification yard traffic turns over an average of three times per day. (Some cars may be held 48 hours; others may clear in less than 8 hours.)

i. Cars should be classified by commodity—POL trains, refrigerator trains, ammunition trains, or ration trains—for one destination where possible. Where solid classified trains are not operationally feasible, the number of blocks per train should average three classes of commodities and/or destinations. When trains are built up for two or more destinations, the blocks must be in proper setoff order to prevent delay if blocks are to be set off en route.

12-18. Planning Formulas for Classification Yards

The following formulas may be used to determine classification yard requirements and capabilities:

a. *Required length of Yard Tracks.* The length of yard tracks is determined by the following computation:

$$LT = ACT \times LC \times 1.2 + 300 \text{ ft (91 m)}$$

where

LT = length of track

ACT = average cars per train

LC = length of car (average)

1.2 = operational factor (to allow for overall length of car coupler rather than car length)

300 ft = clearance distance at each end of track from point of switch to clearance

b. Minimum Number of Tracks Required.

The following computation is used to determine minimum tracks required:

$$NTR = \frac{TD's}{3} \times 1.6$$

where

NTR = number of tracks required

TD's = sum of train densities of using divisions

3 = turnover per day

1.6 = 60 percent factor of static capacity

When computing requirements for a terminal yard, the result obtained in this formula must be doubled. The formula does not apply necessarily to railheads since classification of cars is not always necessary at railheads.

c. Static Yard Capacity. Static yard capacity is determined as follows:

$$SYC = ACT \times NT$$

where

SYC = static yard capacity (in cars)

ACT = average cars per train

NT = number of tracks of the length determined as in *a* above

Daily yard capacity is equal to 1.6 times static yard capacity. This figure takes into account

that the number of cars in a yard at any given time will not exceed 60 percent of the static capacity.

12-19. Planning Factors for Terminals With and Without Receiving and Forwarding Yards

a. With Receiving and Forwarding Yards.

Where trains are operated into and out of terminals at 48-minute intervals, there should be a minimum of six tracks plus one runaround track in both the receiving and forwarding train yards to handle empty and loaded trains. In general, the number of tracks required equals the train density divided by 5, plus 1.

$$NT = \frac{TD}{5} + 1$$

b. Without Receiving and Forwarding Yards. Normally, receiving and forwarding train yards will be in balance with classification and main line capacity. However, some railways dispense with receiving and forwarding yards and operate all trains directly into and out of classification yards. In such cases, the classification yard daily capacity is reduced by approximately 25 percent.

c. Two-Way Tonnage Traffic in Terminals.

In large terminals where tonnage traffic is two-way, the various yards normally are designed with yards for each direction; that is, northbound receiving, classification, and forwarding yards and southbound receiving, classification, and forwarding yards.

Section IV. RAILWAY EQUIPMENT REQUIREMENTS

12-20. General

a. Availability of equipment in liberated or occupied territory depends upon inventories, extent of destruction, condition of equipment, types of fuel and local availability, availability of repair parts, types of coupling devices, and many other such factors. Allowances for use of captured or locally available equipment should be based on judgment after evaluation of the many factors involved.

b. Technical data concerning railway equipment may be found in strategic surveys, special

transportation studies based on intelligence reports, reports of governments or railways in peacetime, and sometimes in publications such as *Railway Gazette* (British) and *Railway Age* (American).

c. Equipment requirements to be considered in planning fall into three categories:

(1) Rolling stock, consisting of boxcars, gondolas, flatcars, tankcars, and refrigerator cars.

(2) Road engines, the motive power used to pull trains between terminals or division points.

(3) Switch engines, the motive power used to switch cars within yards or at division terminals.

d. Appendix B (third and fourth computations) provides an illustrative example of step-by-step procedures for determining railway equipment requirements.

12-21. Rolling Stock

a. Freight.

(1) Requirements are computed separately for operations between major supply installations or areas on each rail system as follows:

$$\text{Total cars required} = \frac{\text{EDT (by type car)}}{\text{avg payload for type car}}$$

$$\times \text{turnaround time} \times 1.1$$

(2) The first factor of this formula, $\frac{\text{EDT (by type car)}}{\text{avg payload for type car}}$, is obtained from that

part of the computation for 1 day's dispatch (1 DD) which determines the number of cars by type required to transport all or a given portion of the end delivery tonnage (EDT) of a rail system. An illustration of the application of this factor to the above stated formula is contained in appendix B (third computation).

(3) Turnaround time is the estimated number of days required for a car to make a complete circuit of the rail system. It is the days elapsed from the time the car is placed at the point of origin for loading until it is moved to its destination, unloaded, and returned to its point of origin. Such time may be computed as follows: 2 days at origin, 1 day at destination, and 2 days in transit (1-day forward movement, 1-day return movement) for each division or major portion thereof which the cars must traverse. This method, rather than an actual hour basis, is used to incorporate delays due to terminal and way station switching as well as in-transit rehandling of trains.

(4) The 1.1 factor is used to express a 10-percent reserve factor which provides for a cushion of extra cars to meet operational peaks, commitments for certain classes of cars, and bad order cars.

(5) Planning factors for net load per freight car are as follows:

Standard gage to broad gage

U. S. equipment	20 short tons (18.14 metric tons)
Foreign equipment	10 short tons (9.07 metric tons)

Narrow gage

U. S. equipment	15 short tons (13.61 metric tons)
Foreign equipment	7½ short tons (6.8 metric tons)

(6) Tank car requirements are computed separately, based on bulk POL requirements, tank car capacities, and computed turnaround time.

b. *Passenger.* Passenger car requirements vary, depending upon troop movement policies, evacuation policies, and rest and recuperation policies. Theater passenger car requirements normally are fulfilled by acquisition of local equipment, with the exception of equipment required for hospital cars or trains.

c. *Disposition of Rolling Stock.* Table C-6 shows the disposition of rolling stock for the operation of a railway system.

d. *1 Day's Dispatch (1 DD).* The term 1 day's dispatch is the number of cars dispatched in a day from the base of operations. For planning purposes, the number of cars dispatched from a division terminal, railhead, or other dispatch point is considered the same as the number dispatched from the base of operations. The following formula is used to determine the rolling stock for 1 day's dispatch:

$$1 \text{ DD} = \frac{\text{EDT (by type car)}}{\text{avg payload for type car}}$$

Computations are made for each type of car to be used (boxcars, gondolas, flatcars) and the sum of the results for all the types of cars computed is 1 day's dispatch for the system (third computation, app B).

12-22. Road Engines

The number of road engines required for operation over a given railway division may be determined by the following formula (fourth computation, app B):

Road engines required =

$$TD \times \frac{RT + TT}{24} \times 2 \times 1.2$$

where

TD = train density

RT = running time (length of division divided by average speed)

TT = terminal time (time for servicing and turning locomotive (table C-7))

24 = number of hours per day

2 = constant for two-way traffic

1.2 = constant allowing 20-percent reserve

$\frac{RT + TT}{24}$ expresses the time during a 24-

hour period in which a road engine is in service; it is called the engine factor. This factor provides for motive power which may make more than one trip per day over a short division.

12-23. Switch Engines

a. No two port, division, or terminal railheads are alike in design or operation; how-

ever, the functions of the main yards in each are essentially the same. Receiving cars from whatever sources and classifying and reassembling them for delivery or forward movement constitute the main functions of any yard. The type of motive power used for these operations is the switch engine.

b. The number of switch engines required at a terminal is based on the number of cars dispatched and received at, or passing through, the terminal per day. When the number of cars has been computed, that figure is applied to the factors contained in table C-8 (app C) to determine the number of switch engines required at each terminal.

c. When the total number of switch engines required for the railway line has been computed, 20 percent is added as a reserve to allow for maintenance, operational peaks, etc. (fourth computation, appendix B).

Section V. RAILWAY PERSONNEL AND UNIT REQUIREMENTS

12-24. General

a. Requirements for transportation railway service units and personnel are based upon the following factors:

(1) *Number of divisions in the system.* This provides a guide to determine the number of battalions required for operation.

(2) *Number of train operating crews required to operate road and switch engines.* This provides a guide to determine the number of train operating companies required in the system.

(3) *Maintenance requirements for right-of-way, locomotives, and rolling stock.* This provides a guide to determine the number and type of maintenance units and personnel required.

b. On the basis of these factors, unit and organization capabilities and normal employment procedures can be used to organize a command structure and to determine support requirements.

12-25. Road Crews

a. In computing the number of road crews required for each division, the total time computed includes the preparation time as follows:

(1) A 2-hour period at the originating terminal for the crew to receive orders and instructions, test the air, and check the train.

(2) Running time involved, which is computed by dividing the length of the division by the average speed of the train. If information is not available to compute the speed, the speed may be assumed to be 10 miles per hour. Normally, running time over a division will be about 12 hours.

(3) A 1-hour period at the final terminal to submit necessary reports.

b. Normally, the running time should not exceed 12 hours in order to allow sufficient time for the crews to rest. This time can be exceeded for short periods in emergencies, although experience shows that safety and efficiency decrease when crews have to work

continuous daily shifts of more than 12 hours. However, it is possible to work shifts of 16 to 18 hours, provided the crews have a sufficient period of rest before reporting for another run. Sometimes it will be necessary to designate longer hours because of the length of the division involved. In such cases, enough time off between runs should be permitted to limit the average daily shift to 12 hours.

c. The following formula may be used in determining the number of road crews needed per division (fifth computation, app B):

Number of road crews =

$$TD \times 2 \times \frac{RT + 3}{12} \times 1.25$$

where

- TD = train density
- 2 = factor to convert to two-way traffic
- RT = running time (length of division divided by average speed)
- 3 = 2 hours allowed for preparation at originating terminal plus 1 hour at final terminal
- 12 = 12-hour shift per road crew per day
- 1.25 = constant factor to allow for ineffectives

12-26. Switch Crews

To determine the number of switch crews required, the number of switch engines in use at each terminal must be known. Two crews are required per switch engine per day. The following formula may be used to determine the number of switch crews required for each terminal (do not compute crews for reserve switch engines) (fifth computation, app B):

Number of switch crews = $SE \times 2 \times 1.25$
where

- SE = number of switch engines
- 2 = two crews per engine
- 1.25 = constant factor to allow for ineffectives

12-27. Railway Unit Requirements

Although guidelines are provided in unit capabilities, length of railway divisions and types of operations may vary; thus all factors of rail operations must be considered in establishing an organizational structure. Normally, the transportation railway service is organized as illustrated in figure 1-1, and units are attached in accordance with their capabilities and functions (paras 2-4 to 2-12).

Section VI. RAILWAY SUPPLY REQUIREMENTS

12-28. General

Generally, railway supply tonnages are quite large. Experience has shown that approximately 5 to 10 percent of the tonnage hauled over the second and third divisions of a railway and 15 percent of the tonnage hauled over each succeeding division are railway operating supplies. Paragraphs 12-29 to 12-31 below demonstrate the method of arriving at specific supply requirements; namely, fuel, lubricants, and repair parts.

12-29. Fuel Consumption of Diesel-Electric Locomotives

Table C-9 (app C) contains an estimated average rate of diesel fuel oil consumption in gallons per train-mile for diesel-electric road locomotives and in gallons per hour of operation for switch engines. For planning purposes, the operation of switch engines is assumed to be 20

hours per day. The method of determining fuel oil requirements in gallons for road locomotives and switch engines is as follows:

a. *Road Locomotives* (Sixth Computation, app B).

(1) Multiply the train density of the first division by 2 (for two-way travel), then multiply the result by the length of the division; this result is the train-miles per day for the division.

(2) Repeat this procedure for each division of the system.

(3) Total the daily train miles for all divisions.

(4) Multiply the total daily train miles by the fuel consumption factor (table C-9, app C) to get the daily fuel requirement.

(5) Multiply the daily fuel requirement by 30 to obtain the monthly fuel requirement.

(6) Add 5 percent to this computed total to provide a reserve for contingencies.

b. Switch Engines (Sixth Computation, app B).

(1) Multiply the total number of switch engines required (do not include reserve engines) by 20 to determine the total hours per train day of operation.

(2) Multiply the total hours per train day of operation by the fuel consumption factor of the engine concerned (table C-9, app C); this result is the daily fuel requirement in gallons.

(3) Multiply the daily fuel requirement by 30 to obtain the monthly fuel requirement.

(4) Add 5 percent to this computed total to provide a reserve for contingencies.

12-30. Lubricants (Sixth Computation, app B)

Lubricants must be used on all moving parts of railway tools, appliances, and machinery and on all motive power and rolling stock. However, for planning purposes only the lubricants necessary for the operation of motive power and rolling stock will be considered. Lubricating oil and grease requirements for motive power and rolling stock are based on an estimate of 1,000 pounds per month for each train moving in either direction over each division in 1 day. The following method is used to determine the amount of lubricants required:

a. Multiply the train density of the first division by 2 (for two-way travel), and multiply

the result by 1,000 to find the amount in pounds of lubricants required per month for the division.

b. Repeat this procedure for each division of the system.

c. Total the pounds of lubricants for all divisions to determine the grand total in pounds required per month for the railroad.

12-31. Repair Parts (Sixth Computation, app B)

In a theater, supplies and repair parts seldom are found in the number and of the kind necessary to maintain the motive power and the rolling stock used by the transportation railway service. For planning purposes, only the repair parts necessary for the maintenance of motive power and rolling stock are considered. An estimate of repair parts required is based on a factor of 1.5 short tons per month for each train moving in either direction over each division in 1 day. The following method is used to determine repair parts required:

a. Multiply the train density of the first division by 2 (for two-way travel), and multiply the result by 1.5 to get the total amount in short tons of repair parts required per month for the division.

b. Repeat this procedure for each successive division of the system.

c. Total the amounts to determine the grand total of short tons required per month for the entire railroad.

APPENDIX A

REFERENCES

A-1. Field Manuals

5-34	Engineer Field Data.
5-35	Engineers' Reference and Logistical Data.
8-10	Medical Service, Theater of Operations.
11-23	U.S. Army Strategic Communications Command (Theater).
19-30	Physical Security.
19-45-1	Rear Area Protection.
(TEST)	
21-40	Chemical, Biological, and Nuclear Defense.
21-41	Soldier's Handbook for Defense Against Chemical and Biological Operations and Nuclear Warfare.
23-65	Browning Machinegun, Caliber .50, HB, M2.
24-18	Field Radio Techniques.
24-20	Field Wire and Field Cable Techniques.
27-10	The Law of Land Warfare.
29-30	Maintenance Battalion and Company Operations in Divisions and Separate Brigades.
30-5	Combat Intelligence.
30-10	Terrain Intelligence.
31-23	Stability Operations, U.S. Army Doctrine.
41-10	Civil Affairs Operations.
44-1	U.S. Army Air Defense Artillery Employment.
55-4	Transportation Movements in Theaters of Operation.
55-6	Transportation Services in Theaters of Operation.
55-8	Transportation Intelligence.
55-10	Transportation Movements Services, Field Army.
55-15	Transportation Reference Data.
100-5	Operations of Army Forces in the Field.
100-10	Combat Service Support.
101-5	Staff Officer's Field Manual—Staff Organization and Procedure.
101-10-1	Staff Officer's Field Manual—Organizational, Technical, and Logistical Data; Unclassified Data.
101-10-2	Staff Officer's Field Manual—Organizational, Technical, and Logistical Data; Extracts of Organization and Equipment.
101-40	Armed Forces Doctrine for Chemical and Biological Weapons Employment and Defense.

A-2. Technical Manuals

3-220	Chemical, Biological, and Radiological (CBR) Decontamination.
5-370	Railroad Construction.
5-627	Railway Track Maintenance; Repairs and Utilities.

5-700	Field Water Supply
11-5820-401-series	
11-5820-498-series	
38-750	Army Equipment Record Procedures.
55-200	Railway Operating Rules.
55-202	Operation and Maintenance of Diesel-Electric Locomotives.
55-203	Maintenance of Railway Cars.
55-204	Maintenance of Railroad Way and Structures.
55-206	Railway Train Operations.
55-601	Troop Movement Guide.

A-3. Army Regulations

55-26	Transportation Movements.
55-355	Military Traffic Management Regulation.
55-650	Military Railroads.
310-3	Department of the Army Publications—Preparation, Coordination, and Approval.
320-5	Dictionary of United States Army Terms.
320-50	Authorized Abbreviations and Brevity Codes.
345-210	Records Management Files Systems and Standards.
380-5	Safeguarding Defense Information.
380-55	Safeguarding Defense Information in Movement of Persons and Things.
725-50	Requisitioning, Receipt, and Issue System.
735-35	Supply Procedures for TOE and TDA Units or Activities.
746-5	Marking and Packing of Supplies and Equipment: Color and Marking of Army Materiel.
750-1	Maintenance Concepts.

A-4. Department of the Army Pamphlets

55-1	Transportation Railway Service.
690-80	Administration of Foreign Labor During Hostilities.

A-5. Tables of Organization and Equipment

5-305	Engineer Topographic Battalion, Army.
8-520	Ambulance Train, Rail.
11-500	Signal Service Organization.
12-67	Personnel Service Company.
14-17	Finance Direct Support Company.
29-500	Composite Service Organization.
TOE 29-510 (Tentative)	Composite Maintenance Organization.
30-600	Military Intelligence Organization.
TOE 55-200	General Headquarters, Transportation Railway Service.
TOE 55-201	Headquarters and Headquarters Company, Transportation Railway Brigade.
55-202	Headquarters and Headquarters Company, Transportation Railway Group.
55-217	Transportation Electric Power Transmission Company.

- 55-226 Headquarters and Headquarters Company, Transportation Railway Battalion.
- 55-227 Transportation Railway Engineering Company, Transportation Railway Battalion.
- 55-228 Transportation Railway Equipment Maintenance Company, Transportation Railway Battalion.
- 55-229 Transportation Train Operating Company, Transportation Railway Battalion.
- 55-247 Transportation Diesel-Electric Locomotive Repair Company.
- 55-248 Transportation Railway Car Repair Company (General Support).
- 55-500 Transportation Service Organization, Headquarters Units.
- 55-520 Transportation Railway Service Teams.



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APPENDIX B

RAILWAY PLANNING—EXAMPLE *

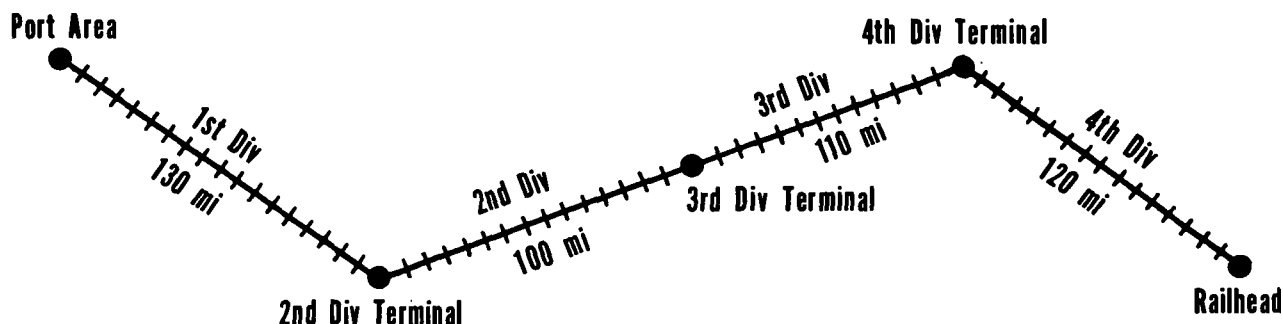


Figure B-1. Hypothetical rail system for planning.

B-1. Situation

Plan for the operation of a rail system to move supplies in a theater of operations; target date for initiation of service, 1 December. All rail tonnages originating in the port will be routed to the railhead over the main line of the system illustrated in figure B-1.

Note 1. All tonnages are expressed and computed in short tons (STON).

Note 2. All computations resulting in a fraction are raised to the next higher whole number.

B-2. Planning Data

a. Track.

Number	Single track
Gage	Standard (56½ inches)
Condition	All divisions—good to fair
Ruling grade	All divisions—1.5%
Ruling curve	All divisions—5°
Weather	All divisions—
	Summer: +60° F to +95° F
	Winter: +35° F to -20° F
	Wet weather: Local and temporary

Passing tracks	1st division—15
	2nd division—9
	3rd division—11
	4th division—14

b. Motive Power.

Road engines—U.S. Army 0-6-6-0, 120 tons, diesel-electric locomotive.

Switch engines—U.S. Army 0-4-4-0, 60 tons, diesel-electric locomotive.

c. Rolling Stock.

Boxcars	40-ton rated capacity
Gondolas	40-ton rated capacity
Flatcars	50-ton rated capacity

d. Operating Personnel. U.S. Army.

B-3. First Computation

Determine the train density (TD) for each of the four railway divisions (para 12-13c).

$$TD = \frac{NT + 1}{2} \times \frac{24 \times S}{LD}$$

$$S = 10 \text{ mph (table C-4)}$$

a. Step 1.

$$\begin{aligned} \text{1st Div: } TD &= \frac{15 + 1}{2} \times \frac{24 \times 10}{130} \\ &= \frac{16 \times 240}{2 \times 130} \end{aligned}$$

*Paragraph notations in this appendix refer to paragraphs in chapter 12 of the text.

$$\begin{aligned}
 &= \frac{3840}{260} \\
 &= 14+ \text{ or } 15 \text{ trains}
 \end{aligned}$$

b. Step 2.

$$\begin{aligned}
 \text{2nd Div: } TD &= \frac{9 + 1}{2} \times \frac{24 \times 10}{100} \\
 &= \frac{10 \times 240}{2 \times 100} \\
 &= \frac{2400}{200} \\
 &= 12 \text{ trains}
 \end{aligned}$$

c. Step 3.

$$\begin{aligned}
 \text{3rd Div: } TD &= \frac{11 + 1}{2} \times \frac{24 \times 10}{100} \\
 &= \frac{12 \times 240}{2 \times 110} \\
 &= \frac{2880}{220} \\
 &= 13 + \text{ or } 14 \text{ trains}
 \end{aligned}$$

d. Step 4.

$$\begin{aligned}
 \text{4th Div: } TD &= \frac{14 + 1}{2} \times \frac{24 \times 10}{120} \\
 &= \frac{15 \times 240}{2 \times 120} \\
 &= \frac{3600}{240} \\
 &= 15 \text{ trains}
 \end{aligned}$$

B-4. Second Computation

a. General. Determine the end delivery tonnage of this rail line, using single engine operation (winter season). To do this, the following formulas must be used:

- (1) $EDT = NDT$ of most restrictive division (para 12-15).
- (2) $NDT = NTL \times TD$ (para 12-14).
- (3) $NTL = GTL \times .50$ (para 12-12).
- (4) $GTL = \frac{DBP \times W}{RR + GR + CR}$ (para 12-11).
- (5) $DBP = TE_c - (\text{total weight of engine in } STON \times 20 \text{ lb per } STON)$ (para 12-6).
- (6) $TE_c = \frac{TE}{2}$ (para 12-5b).
- (7) $TE = \frac{\text{weight on drivers (lb)}}{25\% \text{ adhesion factor}}$ (para 12-5a).

b. Step 1. Compute the starting tractive effort.

$$\begin{aligned}
 TE &= \frac{\text{weight on drivers (lb)}}{4} \\
 &= \frac{240,000}{4} \\
 &= 60,000 \text{ lb}
 \end{aligned}$$

c. Step 2. Compute the continuous tractive effort.

$$\begin{aligned}
 TE_c &= \frac{TE}{2} \\
 &= \frac{60,000}{2} \\
 &= 30,000 \text{ lb}
 \end{aligned}$$

d. Step 3. Compute the drawbar pull of the road engine.

$$\begin{aligned}
 DBP &= TE_c - (\text{total weight of engine in } STON \times 20 \text{ lb per } STON) \\
 &= 30,000 - (120 \times 20) \\
 &= 30,000 - 2,400 \\
 &= 27,600 \text{ lb}
 \end{aligned}$$

e. Step 4. Compute the gross trailing load.

$$GTL = \frac{DBP \times W}{RR + GR + CR}$$

where

$$DBP = 27,600 \text{ lb (preceding calculation)}$$

$$W = 80\% \text{ (table C-3)}$$

$$RR = 6 \text{ lb per } STON \text{ of train (table C-2)}$$

$$GR = 1.5\% \times 20 \text{ lb per } STON \text{ of train} = 30 \text{ lb per } STON \text{ of train (para 12-8)}$$

$$CR = 5^\circ \times 0.8 \text{ lb per } STON \text{ of train} = 4 \text{ lb per } STON \text{ of train (para 12-9)}$$

$$\begin{aligned}
 GTL &= \frac{27,600 \text{ lb} \times .80}{6 \text{ lb}/STON + 30 \text{ lb}/STON + 4 \text{ lb}/STON} \\
 &= \frac{22,080 \text{ lb}}{40 \text{ lb}/STON} \\
 &= 552 \text{ STON}
 \end{aligned}$$

f. Step 5. Compute the net train load.

$$\begin{aligned}
 NTL &= GTL \times .50 \\
 &= 552 \times .50 \\
 &= 276 \text{ STON}
 \end{aligned}$$

g. Step 6. Compute the end delivery tonnage of the system by determining the net division tonnage (NDT) of the most restrictive division.

$$NDT = NTL \times TD$$

1st div:	$276 \times 15 = 4,140$	STON
2nd div:	$276 \times 12 = 3,312$	STON
3rd div:	$276 \times 14 = 3,864$	STON
4th div:	$276 \times 15 = 4,140$	STON

EDT = NDT of 2nd div (most restrictive)
EDT = 3,312 STON

B-5. Third Computation

Determine the rolling stock requirements for this rail system when operating at maximum capacity during winter months, using single engine operation. Each type of freight car will move the following percentages of the end delivery tonnage:

Boxcars	50 percent of EDT
Gondolas	25 percent of EDT
Flatcars	25 percent of EDT

a. Step 1. Compute the portion of the EDT to be moved in each type of railcar:

Boxcars:	$EDT \times 50\% = 3,312 \times .50 = 1,656$	STON
Gondolas:	$EDT \times 25\% = 3,312 \times .25 = 828$	STON
Flatcars:	$EDT \times 25\% = 3,312 \times .25 = 828$	STON

b. Step 2. Compute rolling stock requirements for 1 day's dispatch (para 12-21). To do this the following formulas must be applied:

$$\text{Total cars required} = \frac{EDT \text{ (by type car)}}{\text{avg payload for type car} \times \text{turnaround time} \times 1.1}$$

$$1 \text{ DD} = \frac{EDT \text{ (by type car)}}{\text{avg payload for type car}}$$

Note. Average payload in tons per type car = $\frac{\text{rated capacity}}{2}$

Thus 1 day's dispatch for all types of cars is computed as follows:

Boxcars: $1 \text{ DD} = \frac{1656}{20} = 82+ \text{ or } 83 \text{ cars}$

Gondolas: $1 \text{ DD} = \frac{828}{20} = 41+ \text{ or } 42 \text{ cars}$

Flatcars: $1 \text{ DD} = \frac{828}{25} = 33+ \text{ or } 34 \text{ cars}$

Total cars in 1 DD = 159 cars

Rolling stock requirements are based on a turnaround time of 11 days as shown in figure B-2. Thus total rolling stock requirements are computed as follows:

$$1 \text{ DD} \times \text{turnaround time} = \text{cars rqr} \times 1.1$$

$$(\text{reverse factor}) = \text{total cars rqr}$$

Boxcars:
 $83 \times 11 = 913 \times 1.1 = 1,004+ \text{ or } 1,005 \text{ cars}$

Gondolas:
 $42 \times 11 = 462 \times 1.1 = 508+ \text{ or } 509 \text{ cars}$

Flatcars:
 $34 \times 11 = 374 \times 1.1 = 411+ \text{ or } 412 \text{ cars}$

Total rolling stock requirements: $1,926 \text{ cars}$

B-6. Fourth Computation

Determine the road and switch engine requirements for the operation of this system at maximum capacity during winter months, using single engine operation.

a. Step 1. Compute for road engines required (para 12-22).

$$\text{Number of road engines} = \frac{TD \times RT + TT}{24} \times 2 \times 1.2$$

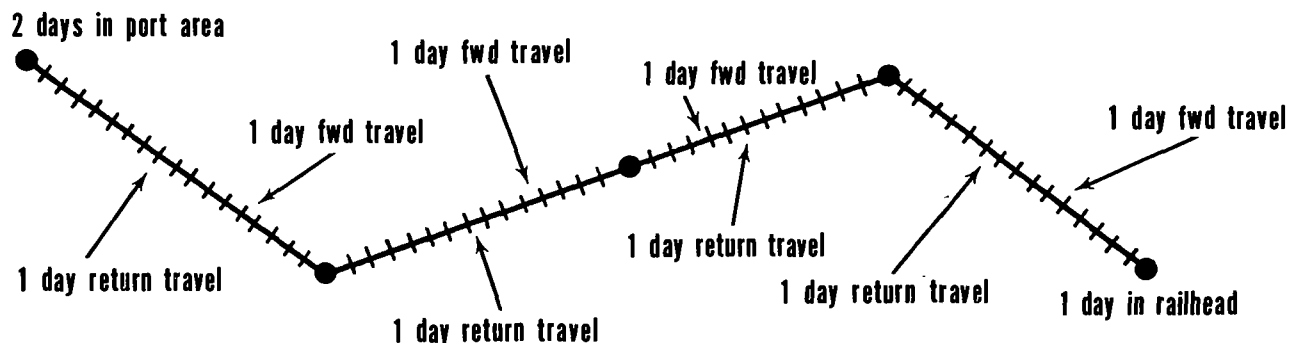


Figure B-2. Determination of turnaround time in days.

(1) Compute for factors.

2nd div: 12 $100 \div 10 = 10$ 3
 3rd div: 14 $110 \div 10 = 11$ 3
 4th div: 15 $120 \div 10 = 12$ 3

1st div: TD $\frac{RT}{(length\ of\ div \div avg\ speed)}$ $\frac{TT}{(table\ C-7)}$
 15 $130 \div 10 = 13$ 3

(2) Compute requirements.

1st div: $15 \times \frac{13 + 3}{24} \times 2 \times 1.2 = 36 \times \frac{16}{24} = \frac{576}{24} = 24$ road engines
 2nd div: $12 \times \frac{10 + 3}{24} \times 2 \times 1.2 = 28.8 \times \frac{13}{24} = \frac{374.4}{24} = 15 +$ or 16 road engines
 3rd div: $14 \times \frac{11 + 3}{24} \times 2 \times 1.2 = 33.6 \times \frac{14}{24} = \frac{470.4}{24} = 19 +$ or 20 road engines
 4th div: $15 \times \frac{12 + 3}{24} \times 2 \times 1.2 = 36 \times \frac{15}{24} = \frac{540}{24} = 22 +$ or 23 road engines

Total road engines required = $24 + 16 + 20 + 23 = 83$ road engines

b. Step 2. Compute for switch engines (para 12-23).

Port	<i>Cars dispatched and received per day</i>	<i>Cars passing per day</i>	<i>Computation factor (table C-8)</i>	<i>Switch engines required</i>
terminal:	159×2		$\div 67$	$= 4 +$ or 5
2nd Div				
terminal:		159×2	$\div 100$	$= 3 +$ or 4
3rd Div				
terminal:		159×2	$\div 100$	$= 3 +$ or 4
4th Div				
terminal:		159×2	$\div 100$	$= 3 +$ or 4
Railhead:	159×2		$\div 67$	$= 4 +$ or 5
			Subtotal	22
			+ 20% reserve (4+ or 5)	5
				27

Road crews = $15 \times 2 \times \frac{13 + 3}{12} \times 1.25$
 $= 37.5 \times \frac{16}{12}$
 $= \frac{600}{12}$
 $= 50$ crews

2nd div:

Road crews = $12 \times 2 \times \frac{10 + 3}{12} \times 1.25$
 $= 30 \times \frac{13}{12}$
 $= \frac{390}{12}$
 $= 32 +$ or 33 crews

3rd div:

Road crews = $14 \times 2 \times \frac{11 + 3}{12} \times 1.25$
 $= 35 \times \frac{14}{12}$
 $= \frac{490}{12}$
 $= 40 +$ or 41 crews

4th div:

Road crews = $15 \times 2 \times \frac{12 + 3}{12} \times 1.25$
 $= 37.5 \times \frac{15}{12}$

B-7. Fifth Computation

Determine the number of train crews required to support this rail system.

a. Step 1. Compute for road crews required (para 12-25).

Road crews = $TD \times 2 \times \frac{RT + 3}{12} \times 1.25$

(1) Compute for factors.

TD	$\frac{RT}{(length\ of\ div \div avg\ speed)}$
1st div: 15	$130 \div 10 = 13$
2nd div: 12	$100 \div 10 = 10$
3rd div: 14	$110 \div 10 = 11$
4th div: 15	$120 \div 10 = 12$

(2) Compute for road crew requirements.

1st div:

$$= \frac{562.5}{12}$$

$$= 46 + \text{or } 47 \text{ crews}$$

$$\text{Total road crews required} = 50 + 33 + 41 + 47 = 171 \text{ road crews}$$

$$\text{Switch crews} = \text{SE} \times 2 \times 1.25$$

Port area:	Switch crews = $5 \times 2 \times 1.25 = 12 +$	or 13
2nd Div terminal:	Switch crews = $4 \times 2 \times 1.25 =$	10
3rd Div terminal:	Switch crews = $4 \times 2 \times 1.25 =$	10
4th Div terminal:	Switch crews = $4 \times 2 \times 1.25 =$	10
Railhead:	Switch crews = $5 \times 2 \times 1.25 = 12 +$	or 13
Total switch crews required =		56

c. Step 3. Determine total number of train crews required.

$$\begin{aligned} \text{Road crews} &= 171 \\ \text{Switch crews} &= 56 \\ \text{Total engine crews} &= \underline{227} \end{aligned}$$

$$\begin{aligned} &973,500 \text{ gal per month} \\ &48,675 \text{ plus } 5\% \text{ reserve} \\ &\underline{1,022,175} \text{ total gal per month} \end{aligned}$$

b. Step 2. Compute fuel requirements for switch engines (para 12-29 and table C-9). (Do not include reserve switch engines.)

per month

$$\begin{aligned} 3,520 \text{ gal per day} \times 30 \text{ days} &= 105,600 \text{ gal} \\ 105,600 \text{ gal per month} \\ 5,280 \text{ plus } 5\% \text{ reserve} \\ \underline{110,880} \text{ gal per month} \end{aligned}$$

B-8. Sixth Computation

Determine the monthly engine fuel, lubricants, and repair parts requirements for the operation of this system.

a. Step 1. Compute fuel requirements for road engines (para 12-29 and table C-9).

	TD	×	Two-way travel	×	LD	=	Train miles per day
1st div:	15	×	2	×	130	=	3,900
2nd div:	12	×	2	×	100	=	2,400
3rd div:	14	×	2	×	110	=	3,080
4th div:	15	×	2	×	120	=	3,600
Total train miles per day =							12,980

$$\begin{aligned} 12,980 \text{ train miles per day} \times 2.5 \text{ gal per train mile} &= 32,450 \text{ gal per day} \\ 32,450 \text{ gal per day} \times 30 \text{ days} &= 973,500 \text{ gal per month} \end{aligned}$$

c. Step 3. Compute total fuel requirement.

$$\begin{aligned} 1,022,175 \text{ road engine requirements per month in gallons} \\ 110,880 \text{ switch engine requirements per month in gallons} \\ \underline{1,133,055} \text{ total requirements per month in gallons} \end{aligned}$$

No. of switch engines	×	Hrs per day operation	×	Rate of fuel consumption (gal per hr per locomotive) =	Daily requirement (gal)
22	×	20	×	8	= 3,520

d. Step 4. Compute monthly lubricant requirements (para 12-30).

TD	×	Two-way travel	×	Lubricants (lb per mo per train per day)	=	Lubricants (lb per month)
1st div:	15	×	2	×	1,000	= 30,000
2nd div:	12	×	2	×	1,000	= 24,000
3rd div:	14	×	2	×	1,000	= 28,000
4th div:	15	×	2	×	1,000	= 30,000
Total lubricants required per month =						112,000 lb

e. Step 5. Compute monthly repair parts requirements in short tons (para 12-31).

	<i>TD</i>	×	<i>Two-way travel</i>	×	<i>Repair parts (STON per mo per train per day)</i>	=	<i>Repair parts (STON per month)</i>
1st div:	15	×	2	×	1.5	=	45
2nd div:	12	×	2	×	1.5	=	36
3rd div:	14	×	2	×	1.5	=	42
4th div:	15	×	2	×	1.5	=	45
Total spare parts per month =							<u>168 STON</u>

APPENDIX C

STATISTICS FOR USE IN RAILWAY PLANNING

Table C-1. Characteristics of United States Army Locomotives

Type of locomotive	Weight on drivers (STON)	Starting TE (lb) ¹	Total weight (STON)	Minimum radius curve (ft)
Standard gage (56½-in.), stock No. 2210-554-0786, locomotive, diesel-electric, 131-ton, 0-6-6-0 wheel, domestic and foreign service (1,000-hp)	131	75,700	131	231
Stock No. 2210-270-1354, locomotive, diesel-electric, 127-ton, 0-6-6-0 wheel, domestic and foreign service (1,000-hp)	127	75,700	127	231
Standard gage (56½-in.), stock No. 2210-262-0751, locomotive, diesel-electric, 120-ton, 0-4-4-0 wheel, domestic service (1,200-hp)	120	72,000	120	193
Stock No. 2210-554-0785, locomotive, diesel-electric, 120-ton, 0-4-4-0 wheel, domestic service (1,500-hp)	120	72,000	120	150
Stock No. 2210-112-8508, locomotive, diesel-electric, 115-ton, 0-4-4-0 wheel, domestic service (1,000-hp)	115	69,000	115	50
Stock No. 2210-112-8510, locomotive, diesel-electric, 65-ton, 0-4-4-0 wheel, domestic service (400-hp)	65	39,000	65	75
Stock No. 2210-821-1135, locomotive, diesel-electric, 45-ton, 0-4-4-0 wheel, domestic and foreign service (380-hp)	45	27,000	45	50
Stock No. 2210-529-9038, locomotive, diesel-electric, 45-ton, 0-4-4-0 wheel, domestic service (380-hp)	45	27,000	45	75
Stock No. 2210-820-5602, locomotive, diesel-electric, 44-ton, 0-4-4-0 wheel, domestic service (380-hp)	44	26,400	44	75
Stock No. 2210-262-1366, locomotive, diesel-mechanical, 10-ton, 0-4-0 wheel, domestic service (100-hp)	10	6,666	10	75
Stock No. 2210-820-5451, locomotive, diesel-electric, 80-ton, 0-4-4-0 wheel, domestic service (470-hp)	80	48,000	80	75
Stock No. 2210-287-8901, locomotive, diesel-electric, 60-ton, 0-4-4-0 wheel, domestic and foreign service (500-hp)	60	30,500	60	75

¹ For diesel-electric power, the continuous tractive effort (TE_c) is one-half the starting TE.

Table C-2. Average Values of Rolling Resistance

Pounds per ton of train	Condition of track
5 -----	Exceptionally good
6 -----	Good to fair
7 -----	Fair to poor
8 -----	Poor
9 and 10 -----	Very poor

Table C-3. Effect of Weather on Hauling Power of Locomotives

Most adverse temperature in °F	Loss in hauling (percent)	Weather factor (percent)
Above +32 -----	0	100
+16 to +32 -----	5	95
0 to +15 -----	10	90
-1 to -10 -----	15	85
-11 to -20 -----	20	80
-21 to -25 -----	25	75
-26 to -30 -----	30	70
-31 to -35 -----	35	65
-36 to -40 -----	40	60
-41 to -45 -----	45	55
-46 to -50 -----	50	50

Table C-4. Determining Average Speed Values

Condition of track	Percent of grade	Average speed (mph)	
		Single track	Double track
Exceptionally good -----	1 percent or less	12	14
Good to fair -----	1.5 percent or less	10	12
Fair to poor -----	2.5 percent or less	8	10
Poor -----	3 percent or less	6	8

Notes.

1. The most restrictive factor governs the speed selected.

2. In using the table for average speed factor, consider the following:

a. If the condition of track and/or the percent of grade is not known, use an average speed value of 8 miles per hour for single track and 10 miles per hour for double track.

b. Where the most restrictive factor occurs for a comparatively short distance—that is, less than 10 percent of the division—use the next higher average speed.

c. Where average speed falls below 6 miles per hour because of the grades, reduce the tonnage to increase speed (2-percent reduction in gross tonnage will increase speed 1 mile per hour).

Table C-5. Characteristics of Rolling Stock

A. U.S. Rolling Stock:

Type of car	Gage	Capacity (tons)	Tare weight (tons)	Inside dimensions		
				Length	Width	Height
<i>Foreign service:</i>						
Box, 30-ton -----	Narrow	30	13.6	34'5 1/2"	7' 3/4"	6'4"
Box, 40-ton -----	Std to broad	40	18.5	40'6"	8'6"	6'5 5/8"
Flat, 30-ton -----	Narrow	30	10.9	34'5 7/8"	7'2"	
Flat, 40-ton -----	Std to broad	40	14.5	40'9"	8'7 1/4"	
Flat, 80-ton -----	Std to broad	80	35.3	46'4"	9'8"	
Flat, depressed center, 70-ton -----	Std to broad	70	41.5	50'7"	9'8"	
Gondola, high-side, 30-ton -----	Narrow	30	13	34'5"	6'10 1/2"	4'0"
Gondola, high-side, 40-ton -----	Std to broad	40	18	40'0"	8' 3 3/4"	4'0"
Gondola, low-side, 30-ton -----	Narrow	30	12.1	34'6"	6'10 1/2"	1'6"
Gondola, low-side, 40-ton -----	Std to broad	40	16	40'4 1/2"	8' 3 1/4"	1'6"
Tank, POL, 6,000-gal -----	Narrow	20	16			
Tank, POL, 10,000-gal -----	Std to broad	35	19			
<i>Domestic service:</i>						
Box, 50-ton -----	Std	50	23	40'6"	9'2"	11'0"
Flat, 50-ton -----	Std	50	25.5	43'3"	10'6"	
Flat, 70-ton -----	Std	70	27	49'11"	10'3"	
Flat, 100-ton -----	Std	100	35	54'0"	10'6 1/2"	
Gondola, high-side, 50-ton -----	Std	50	25	41'6"	9'6"	4'6"
Gondola, low-side, 50-ton -----	Std	50	23	41'6"	9'6"	3'0"
Tank, POL, 10,000-gal -----	Std	50	23	42'1 1/2"		

B. European Rolling Stock:

Flat, 66-ton (SSys 55) -----	Std	67	22.5	35'3 3/16"	31'2"	10'4"
Flat, 55-ton (SSys 45) -----	Std	57	17.8	35'3 3/16"	31'2"	9 1/2"

Type of car	Gage	Capacity (tons)	Tare weight (tons)	Inside dimensions		
				Length	Width	Height
Flat, 90-ton (FFlm)	Std	95	32.5	50'11 7/8"	46'8"	10'3"
Flat, 88-ton (SSym 46)	Std	90	24.5	43'4"	39' 1/2"	10'4"
Flat, 46-ton (FF1)	Std	47.4	31.8	66'11 3/16"	62'3 1/4"	10'
Flat, 50-ton (FF)	Std	50	18.2	44'9 13/16"	40'9"	8'7 1/8"
Tank, 16,000-gal	Std	69.3	23.9	40'8 1/4"		
Tank, 9,900-gal	Std	40	17.4	40'9 3/4"		
Tank, 10,000-gal	Std	40	18.6	42'1 1/2"		

Note. Average payload for each type of car, except tank cars, is 50 percent of rated capacity in tons.

Table C-6. Disposition of Rolling Stock

Disposition	Rolling stock required
At base of operation ...	2 day's dispatch
Forward traffic	1 day's dispatch per division
Return traffic	1 day's dispatch per division
At the railhead	1 day's dispatch

Table C-7. Terminal Time Average Values

Type of motive power	Hours
Diesel-electric	3

Table C-8. Disposition of Switch Engines

Location	Switch engines required
Port or loading terminal	1 per 67 cars dispatched and received per day
Division terminals	1 per 100 cars passing per day
Railhead or unloading terminals	1 per 67 cars dispatched and received per day

Table C-9. Fuel Requirements for Diesel-Electric Locomotives

Type of locomotive	Type of operation	Estimated average rate of fuel oil consumption	
		Gal per train mile	Gal per hour
Standard gage:			
0-6-6-0, 120-ton	Road switcher	2.5	11.5
0-4-4-0, 60-ton	Road switcher	.9	8.0
Narrow gage:			
0-6-6-0, 80-ton	Road switcher	1.5	10.0
0-4-4-0, 48-ton	Road switcher	.9	8.0

Table C-10. Bridge Capacities Expressed in Cooper's E Rating as Reflected in the Dimensions of Stringers

Lower flange			Span length (ft)													
Thickness (in.)	Width (in.)	Stringer depth (in.)	10	11	12	13	14	15	16	17	18	19	20	22	24	26
3/8	8 3/8	18	E-42	E-41	E-41	E-41										
3/8	10 3/8	24		E-59	E-48	E-40	E-35	E-31	E-27						E-26	
1/2	10 3/8	30				E-61	E-59	E-51	E-46	E-41	E-37	E-33	E-30	E-27	E-48	E-43
1/2	12 1/2	30						E-62	E-56	E-50	E-45	E-41	E-37	E-31	E-39	E-34
1	14	36								E-60	E-58	E-55	E-54	E-51		
1/2	12 3/8	42										E-60	E-54	E-45		
1 1/8	14	42											E-63	E-60	E-57	E-54

Lower flange			Span length (ft)													
Thickness (in.)	Width (in.)	Stringer depth (in.)	28	30	35	40	44	50	54	60	64	70	74	80	84	90
1	14	42	E-39	E-34	E-26											
1/2	12 3/8	42	E-30	E-26												
1 1/8	14	42	E-51	E-45												
1 1/8	16	42	E-60	E-54	E-42	E-32										
1 1/2	16	48		E-59	E-52	E-47	E-43	E-33								
1	16	48	E-66	E-57	E-45	E-35	E-30									
1 5/8	14	54			E-54	E-43	E-36	E-28								
1 3/4	14	60				E-60	E-54	E-43	E-37	E-30	E-27					
1 1/2	14	60				E-57	E-48	E-38	E-33	E-27						
2 1/8	15	66						E-57	E-54	E-46	E-41	E-34	E-31	E-26		
2	14	66						E-56	E-48	E-40	E-35	E-30	E-26			
	14	72						E-62	E-54	E-44	E-39	E-32	E-29	E-25		
2 1/2	15 1/2	72							E-55	E-51	E-43	E-38	E-33	E-29		
2 1/8	14	78						E-64	E-52	E-46	E-39	E-35	E-30			
2 1/2	16	84								E-64	E-54	E-49	E-41	E-38	E-30	
2 11/16	20	96													E-59	E-51

Table C-11. Bridge Capacities Expressed in Cooper's E Rating as Reflected in the Dimensions of Rectangular Wooden Stringers

Width (in.)	Depth (in.)	Span length (ft)						
		10	12	14	16	18	20	22
18	12	E-16	E-12					
18	14	E-22	E-18	E-10				
18	16	E-28	E-20	E-15	E-10			
18	18	E-38	E-26	E-18	E-14	E-12		
20	12	E-18	E-12					
20	14	E-25	E-17	E-12				
20	16	E-33	E-23	E-16	E-12	E-10		
20	18	E-43	E-29	E-21	E-16	E-13	E-10	
24	12	E-22	E-15	E-11				
24	14	E-30	E-21	E-14	E-11			
24	16	E-40	E-28	E-20	E-15	E-12		
24	18	E-52	E-36	E-25	E-19	E-15	E-12	E-10
36	12	E-34	E-23	E-17	E-12	E-10		
36	14	E-47	E-32	E-23	E-17	E-14	E-11	
36	16	E-62	E-43	E-30	E-23	E-19	E-15	
36	18	E-78	E-53	E-39	E-30	E-24	E-20	E-16
40	12	E-38	E-26	E-19	E-14	E-11		
40	14	E-52	E-36	E-26	E-20	E-16	E-12	
40	16	E-69	E-47	E-35	E-26	E-21	E-17	
40	18	E-87	E-60	E-44	E-34	E-27	E-22	E-18
48	12	E-46	E-31	E-23	E-17	E-13		
48	14	E-63	E-43	E-31	E-24	E-19	E-15	
48	16	E-83	E-57	E-41	E-32	E-26	E-21	
48	18	E-105	E-73	E-53	E-41	E-33	E-27	E-22
54	12	E-52	E-35	E-27	E-19	E-15		
54	14	E-72	E-49	E-35	E-22	E-18		
54	16	E-94	E-65	E-46	E-36	E-29	E-24	
54	18	E-119	E-82	E-60	E-46	E-38	E-30	E-25
60	12	E-58	E-40	E-30	E-22	E-17		
60	14	E-79	E-55	E-39	E-30	E-25	E-20	
60	16	E-104	E-72	E-52	E-40	E-33	E-27	
60	18	E-132	E-92	E-67	E-52	E-42	E-32	E-28

Note. In computing loading for bridges of wooden stringer construction, use the total width of all stringers under one track and the depth of one stringer.



APPENDIX D

STABILITY OPERATIONS

D-1. General

Stability operations are those types of internal defense and internal development operations and assistance provided by the Armed Forces to maintain, restore, or establish a climate of order within which responsible government can function effectively and without which progress cannot be achieved.

D-2. Technical Assistance and Training

The Army Transportation Railway Service can support stability operations by providing technical assistance and advice relative to the construction, repair, maintenance and operations of railways in the host country. Personnel of the Transportation Railway Service may provide this assistance by various means as the situation dictates. As individuals or small training teams they may be assigned directly to appropriate agencies of the host country to provide technical assistance and advice relative to the operation of the railway transportation system; improvement in the railway training program; modernization and rehabilitation of equipment; improvement of maintenance facilities; and the establishment of movement priority and movement control programs. Another method of providing such assistance to the host country can be in coordination with some other agency of the U.S. Government, such as the U.S. Aid Mission to the host government.

D-3. Military Civic Action

a. The use of military personnel and resources to support or implement a national internal development program is military civic action.

b. The personnel and equipment of the Army Transportation Railway Service may have a great potential for supporting civic action. Al-

though individuals and units are adaptable for certain types of activities because of the nature of their missions and the types of equipment and skills they employ, there are many other areas in which units may contribute because of the varied educational background and vocational experience of unit personnel. Civilian skills in such areas as the building trades, teaching, engineering, forestry, sanitation, mining, animal husbandry, farming, and road construction, if properly applied, can do much assist the economy, health and overall well-being of the civilian community. A partial list of areas in which these skills might be applied follows:

- (1) Assisting in construction projects by providing advice, supplies, and equipment.
- (2) Providing advice, assistance, and equipment for debris removal, land clearance, and drainage projects.
- (3) Providing advice and assistance relative to harvesting crops.
- (4) Repairing and rehabilitating machinery and transport equipment.
- (5) Training indigenous personnel in skills and trades useful to the local economy.
- (6) Providing teachers for schools, and adult vocational and technical training.
- (7) Sponsoring community projects such as orphanages, schools, dispensaries, and civic centers.
- (8) Providing labor, material, equipment, and transport assistance for disaster relief.
- (9) Providing instruction, advice, and assistance in professional areas such as engineering, if such skills are available in the unit.
- (10) Motivating the populace to help themselves by showing them how to get the utmost benefit with the use of locally available materials and tools.



APPENDIX E CONVERSION FACTORS

A. Linear measure.

Meter ¹	Inches	Feet	Yards	Rods	Chains	Miles		Kilometers	Cables' lengths	Fathoms
						Statute	Nautical ²			
1.0	39.37	3.28083	1.09361	0.19884	0.04971	0.0006214	0.0005396	0.001	0.00454	0.546
.0254	1.0	.0833	.0278	.00505	.00126	.00001578	.00001371	.0000254	.000116	.0139
.3048	12.0	1.0	.3333	.0606	.0151	.0001894	.0001645	.0003048	.00139	.167
.9144	36.0	3.0	1.0	.1818	.04545	.005682	.0004934	.0009144	.00417	.500
5.0292	198.0	16.5	5.5	1.0	.25	.003125	.002714	.005029	.0228	2.76
20.1168	792.0	66.0	22.0	4.0	1.0	.0125	.01085	.02012	.091	11.0
1,609.35	63,360.0	5,280.0	1,760.0	320.0	80.0	1.0	.8684	1.6095	7.32	879.0
1,853.25	72,962.5	6,080.2	2,026.73	368.497	92.1243	1.15155	1.0	1.85325	8.46	1,010.0
1,000.0	39,370.0	3,280.83	1,093.61	198.838	49.7096	.6214	.5396	1.0	4.56	546.0
219.5	8,640.0	720.0	240.0	43.6	10.9	.1364	.1184	.2195	1.0	120.0
1.829	72.0	6.0	2.0	.363	.091	.00114	.00098	.00183	.00835	1.0

¹ 1 meter = 10 decimeters = 100 centimeters = 1,000 millimeters.

² A nautical mile is the length on the earth's surface of an arc subtended by 1 minute of angle at the center of the earth. Therefore, the circumference of the earth is equivalent in nautical miles to the number of minutes in a circle (360 × 60 = 21,600).

B. Surface measure.

Square meters	Square inches	Square feet	Square yards	Square rods	Acres	Hectares	Square miles (statute)	Square ki
1.0	1,550.0	10.764	1.196	0.03954	0.000247	0.0001	0.000000386	0.00000
.00065	1.0	.0069	.00077	.00000026	.00000016	.000000065	.0000000025	.00000
.0929	144.0	1.0	.1111	.00367	.00002296	.00000929	.0000000359	.00000
.8361	1,296.0	9.0	1.0	.0331	.0002066	.0000836	.000000323	.00000
25.293	39,204.0	272.25	30.25	1.0	.00625	.000253	.00000977	.00002
4,046.8	6,272,640.0	43,560.0	4,840.0	160.0	1.0	.4047	.00156	.00405
10,000.0	15,499,969.0	107,639.0	11,960.0	395.37	2.471	1.0	.00386	.01
2,589,999.0	Sq ft x 144	27,878,400.0	3,097,600.0	102,400.0	640.0	259.0	1.0	2.59
1,000,000.0	Sq ft x 144	10,763,867.0	1,195,985.0	39,537.0	247.1	100.0	.3861	1.0

C. *Weight.*

Kilograms (kg)	Grains (gr)	Ounces		Pounds		Tons		
		Troy	Avoirdupois (avdp)	Troy	Avoirdupois (avdp)	Short (2,000 lb)	Long (2,240 lb)	Metric (1,000 kg)
1.0	15,432.4	32.1507	35.274	2.67923	2.20462	0.001102	0.0009842	0.001
.0000648	1.0	.002083	.0002286	.0001736	.0001429	.00000007	.00000006	.00000006
.0311	480.0	1.0	1.09714	.08333	.06857	.00003429	.00003061	.0000311
.02385	437.5	.91146	1.0	.07595	.0625	.00003125	.0000279	.00002835
.37324	5,760.0	12.0	13.1657	1.0	.82286	.0004114	.0003674	.0003732
.45359	7,000.0	14.5833	16.0	1.21528	1.0	.0005	.0004464	.004536
907.185	14,000,000.0	29,166.7	32,000.0	2,430.56	2,000.0	1.0	.89286	.90719
1,016.05	15,680,000.0	32,666.7	35,840.0	2,722.22	2,240.0	1.12	1.0	1.01605
1,000.0	15,432,356.0	32,150.7	35,274.0	2,679.23	2,204.62	1.10232	.98421	1.0

APPENDIX F
STANAG 2805E, Annex B
CLASSIFICATION OF RESTRICTIONS AFFECTING THE
MOVEMENT OF CERTAIN MILITARY EQUIPMENT
BY LAND ON CONTINENTAL WESTERN EUROPE

NATO UNCLASSIFIED
ANNEX B (DofA) TO STANAG 2805-E
RAIL MOVEMENTS

Appendixes: 1 to 8 to Annex B (DofA)

LOADING GAUGES

1. A loading gauge exists for railroad transport and has already been covered by international agreement. It is the PPI Gauge (passe-partour international) which is shown on the dimensioned diagram at Appendix 1 to this Annex. (The detailed dimension of the lower parts which do not affect loading conditions are not reproduced on the diagram).
2. A load not exceeding this gauge can travel without limitation on most of the Continental Western Europe lines.
3. A certain number of existing military equipment, heavy or cumbersome, does not come within this gauge when it is loaded on commercial types of waggons adapted to its tonnage.
4. For technical and military reasons it is not always possible to restrict the manufacture of all future equipment to dimensions which are compatible with the limitations of this gauge. In addition, it does not appear to be possible to modify to an acceptable extent the existing rolling stock of the different railroad companies. Although the need to reduce the height is taken into account in the manufacture of new equipment, this is not sufficient because the width of the equipment to be carried affects essentially the infrastructure.
5. Under the conditions of paragraph 4, the PPI gauge is insufficient for the conveying of heavy or cumbersome military equipment which, for this reason, has been called "out-of-gauge equipment".
6. In view of the relatively large number and tactical importance of these equipments it is not possible to:
 - a. Subject them automatically to particular movement regulations which require a preliminary survey of special routes the number which is too restricted and sometimes too difficult to draw up (existing itineraries for "out-of-gauge convoys"), as this would be likely to hinder the movement of ordinary equipment.
 - b. Preclude them deliberately from being conveyed by rail as this would delay considerably their movement to the area when they would be used.

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7. The aim has therefore been to find a larger gauge which would enable most of this equipment to be conveyed on existing waggons on the greatest number of itineraries possible though this would entail the carrying out of alternations on the most restricted lines. This gauge which is a compromise between the requirements and capabilities, has been called "TZ gauge" and is shown on the dimensioned diagram at Appendix 2 to this Annex.

8. A line is said to be available for TZ gauge traffic when it satisfies the following conditions:

- a. In the case of a single track line, the TZ gauge must be cleared without restriction throughout its length.
- b. In the case of a double track line, simultaneous movement of TZ gauge and PPI gauge equipment must be possible through its length in any direction without any restriction other than at a few special points where passing is not allowed. Each nation has to take into account the fact that the gauge TZ is defined for a load of a length not exceeding 283 7/16" (7.20 metres) on a waggon of the same wheelbase. (The maximum dimensions for the width of a load of different length on a waggon having a different wheel-base are defined further on in the STANAG.)

9. It is very desirable that all the lines of all European networks be able to meet these minimum requirements. In view of the fact that it is not yet so (especially as regards the French and Italian networks), the TZ gauge can only be considered as a limiting gauge for restricted movement.

ADOPTION OF THE TZ GAUGE AS THE LIMITING GAUGE FOR RESTRICTED MOVEMENT

10. The TZ gauge as defined in the dimensioned diagram at Appendix 2 has been agreed as being the limited gauge for restricted movement on the railroad networks of Central Europe, DENMARK and ITALY. However, it is understood that all loads exceeding the gauge normal to each administration will continue to be considered as abnormal load and will be the subject of special consideration by the Railway Administration.

DEFINITION OF THE LIMITING STANDARDS FOR EQUIPMENT

11. The limiting loading gauge having been defined, the limiting standards for equipment depend upon the characteristics of the carrying waggons.

12. Flat waggons have been divided into two groups:

- a. Ordinary Waggons.
- b. Special Waggons.

13. Ordinary waggons form the greater part of the railroad companies' rolling stock. They are of many different types and a parallel classification of waggons and equipment is under study for the European area. However, many of these waggons have the same average characteristics as regards the height of the floor. Standards A and B1 (see para 15) are based on these average standards.

14. Special waggons, although far less numerous are nevertheless classified by the Centre-Europe Committee of PBEIST into 5 categories (docu-

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ment AC/15 (CE)D/45), only four of which (5, 6, 7, and 8) are of real value for the carrying out of military movements.

15. In terms of the above factors (TZ and PPI gauges and characteristics of waggons) military equipment can be classified in the following 3 groups:

- a. *Normal Movement* equipment clearing the PPI gauge on ordinary waggons (Group A).
- b. *Restricted Movement* B1 equipment clearing the TZ gauge on ordinary waggons—B2 equipment clearing the TZ gauge on special waggons (Group B).
- c. *Difficult or impossible movement* equipment exceeding the TZ gauge any type of waggon (Group C).

16. The category "equipment clearing the PPI gauge on special waggons" need not be considered as this case arises very rarely in practice.

17. Owing to the diversity of special waggons, it has been found necessary to divide B2 category "equipment clearing the TZ gauge" (see para 15b.) into three sub-categories.

18. Five limited standards have been defined for the manufacture of equipment likely to be conveyed by rail; these standards correspond to the various types of waggon and were selected in the following way: in each category, those waggons were selected, from among the current types, which imposed the most limiting conditions, so that the standards will be valid, in fact, for a large number of waggons; an essential characteristic of the waggons for movement within the curves is the wheel-base of the waggon; the distance between the axis of the outside axles for simple axle waggons and the distance between the pivots of the bogies for waggons constructed with bogies (1). An off-centre correction is given for each standard: a maximum length has also been laid down for the load. Any load complying with these standards can be moved as a "TZ load" in accordance with the definition given in paragraph 8, on any railroad on which the curve radius is 492 ft (150 metres) or more. Paragraphs 25 and 28 explain how the dimensions of these standards should be reduced in the case of longer loads.

NOTE. On the diagrams and the graph which constitute the Appendices to this Annex, the following code has been used:

- l = width of load
- lm = maximum width (width between outside edges of tracks)
- d = width of tracks
- L = length of load
- a = wheel-base of waggon (distance between outside axles or pivots of bogies).

Unless otherwise stated, the measurements given on the diagrams are in millimetres. On the graph, the measurements are in metres.

19. *Standard A.* This is the standard for equipment clearing the PPI

NOTE (1). This wheelbase is marked "a" on the diagrams.

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gauge on ordinary waggons (para 15a.) with off-centre correction of $1\frac{9}{16}$ " (40 mm). The standard waggon selected is one having a width of $101\frac{3}{16}$ " (2.67 m) maximum height of loading floor $50\frac{3}{8}$ " (1.28 m) and wheel-base of 315" (8 m); the maximum length and the maximum STANAG class selected are $413\frac{3}{8}$ " (10.5 m) and class 12 respectively; this corresponds to what is possible with existing waggons. The diagram of the Standard given in Appendix 3 shows maximum dimensions:

a. For a wheeled vehicle loaded on to a waggon having $23\frac{5}{8}$ " (600 mm) sides.

b. For a tracked vehicle loaded on to a waggon without sides, it is accepted that the trucks may project sideways by half a width, with a safety margin of $1\frac{31}{32}$ " (50 mm).

20. *Standard B1*. This is the standard for equipment clearing the TZ gauge on ordinary waggons (para 15b.) with off-centre correction of $1\frac{9}{16}$ " (40 mm). The standard waggon selected and the maximum length are the same as for Standard A. For Standard B1, see diagram at Appendix 4. It should be noted that since the loading floor is at a height of less than $51\frac{19}{32}$ " (1.31 m) (2), the dimensions of the lower parts of the load (in particular, the width taken between the outer edges of the tracks) do not exceed those of Standard A. (To take account of developments in the waggon pool of the railway companies, a new standard, which could be called B11, is under study; if necessary, it could be introduced in this STANAG in addition to or in place of Standard B1.)

21. *Standard B21*. This standard relates to equipment clearing the TZ gauge on special waggons (para 15c.). The standard waggon selected is one of the E4 classification. E4 waggons, which constitute category 8 of the PBEIST classification (para 14) all have very similar characteristics, in particular:

width of floor	124" (3.15 m)
height of floor	$51\frac{19}{32}$ " (1.31 m)
wheel-base	$283\frac{7}{16}$ " (7.20 m)

on the basis of a maximum length of $283\frac{7}{16}$ " (7.20 m) for leading, therefore, the standard "TZ" load defined in para 8 is arrived at. Thus, the only reductions to be made to dimensions of the vehicle in relation to the gauge are those resulting from the loading tolerance; in order to make the fullest possible use of the advantages inherent in these waggons, which are the most useful for the transport of heavy tanks, it has been agreed that loading should be effected with particular care and the off-centre correction has been reduced to $19/32$ " (15 mm). The diagram of this standard is given in Appendix 5.

22. *Standard B22*. This standard relates to wheeled equipment clearing the TZ gauge on special waggons of category 5 in the PBEIST classification. The floor width of the majority of these waggons (classification.

NOTE (2). Level above which the TZ gauge is wider than the PPI gauge.

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index E3) is 111 13/32" (2.83 m), the floor height is 50" (1.27 m) and the wheel-base 366" (9.30m); this is the standard waggon which was selected for the laying down of the standard, accepting a maximum length of load of 433" (11 m) and an off-centre correction of 1 9/16" (40 mm). The diagram of this standard is given in Appendix 6.

23. *Standard B23*. This standard also relates to wheeled equipment clearing TZ gauge on special waggons. The characteristics of the standard waggon selected are as follows:

maximum height of actual floor	:	53 9/16" (1.36 m)
maximum height on bearing joists	:	57 3/32" (1.45 m)
wheel-base	:	503 15/16" (12.80 m)
maximum load corresponding to	:	Approximately 30 STANAG class

Such waggons fall into category 4 of the PBEIST classification; they are relatively narrow, often have metal floors and are not generally used in peacetime for the transport of vehicles; they can however be useful in wartime. The standard has been laid down for a maximum length of load of 15 m and an off-centre correction of 1 9/16" (40 mm). The corresponding diagram is given in Appendix 7.

24. In order to enable military equipment to be transported rapidly and without delay due to a long preliminary study, it is necessary that its transversal measurements be no greater than the standards given above.

25. Details are given below of the exceptions which, in theory, might possibly be made to these standards, but it is pointed out that, in practice, it would be very difficult to benefit from such exceptions. If the stock of special flat waggons of Continental Western Europe were considerably modified, it would be preferable to lay down a new standard allowing for the rational use of new types of waggons, if the number of these justified such action.

- a. For equipment of a length considerably less than the maximum length referred to in the standards, the widths could be increased as indicated in paragraph 28.
- b. In the same way, if waggons having a shorter wheel-base than that laid down were available, either the length or the width of the load could be increased but this would undoubtedly be even more difficult than in the previous case.

26. It could of course be agreed that auxiliary components of the equipment to be transported be allowed to exceed the limits of the standard, provided they can be either detached or dismantled.

27. All equipment, the transverse dimensions of which exceed the limits of the standards and the conditions laid down in paragraphs 25 and 26, would fall into Group C (para 15c) and its conveyance by rail would be very problematic in view of the limitations which could be imposed.

28. The graph at Appendix 8 provides a means of determining what modifications as described in paragraphs 25a and 25b can be made to the

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standards; the graph shows the relationship between the maximum values for the wheel-base of the waggon 'a', the length of the load 'L' and the width of this load 'l' found at the widest point of the vertical part of the limited envelope curve.

- a. The graph has been drawn on the hypothesis that the load is centred on the waggon; in practice, therefore, the value 'c' of the off-centre correction must be applied to the value of 1 obtained from the phase:
 - to find the maximum width corresponding to a given width 1, read off from the graph, twice the corresponding correction must be subtracted ($l_m = 1 - 2c$);
 - where the width of the load l_m is known, the appropriate length L is obtained by adding to this known width twice the off-centre correction, to find the value of 1 to be used on the graph ($1 = l_m + 2c$).
- b. The width 1, read off from the graph and then reduced by subtraction of the off-centre correction, is that of the lower part of the load; it is, therefore, less than the limit of 3.54 m by an amount 's' ($s = 3.54 - 1 + 2c$):
 - to find the width of the load at a given level, subtract 's' from the corresponding value of the TZ gauge;
 - conversely, where the width of a load at a given level is specified, the difference 's' between this value and the corresponding value of the TZ gauge can be calculated; the width 1 to be used on the graph will be the value of "3.54 - s" to which should be applied the off-centre correction ($1 = 3.54 - s + 2c$).

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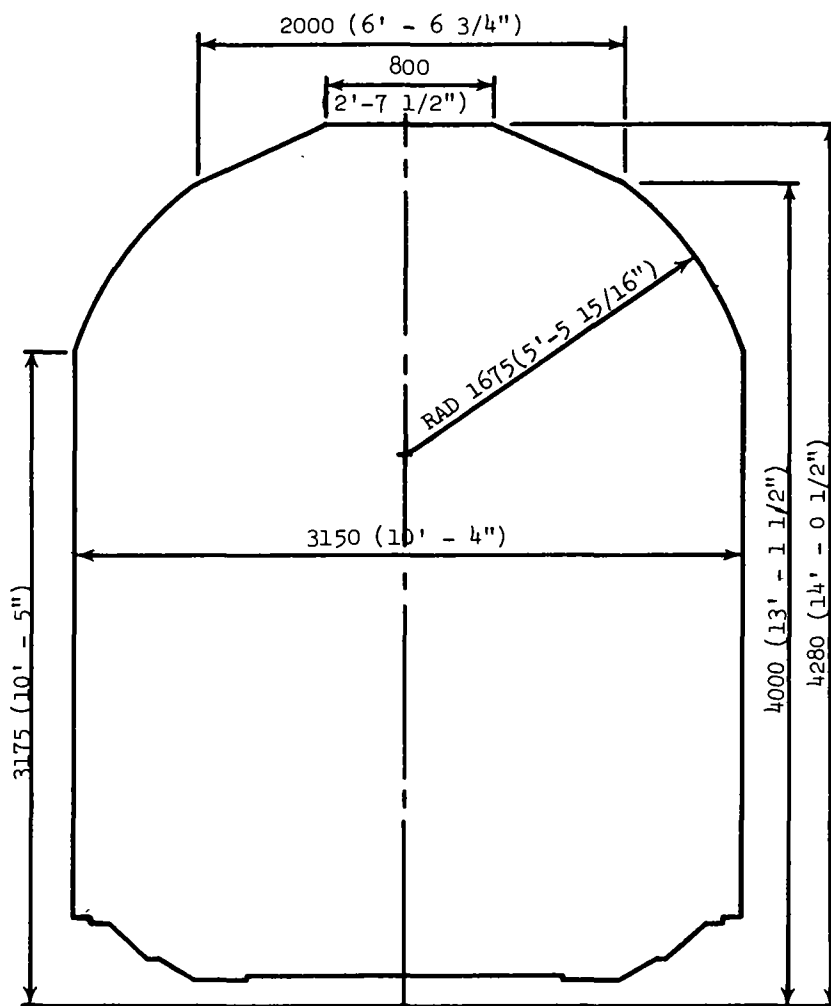
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NATO UNCLASSIFIEDAPPENDIX 1 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 1 A L'ANNEXE B
(MdeA) AU STANAG 2805-EPPI (PASSE-PARTOUT INTERNATIONAL) GAUGES/GABARIT PPI

Dimensions shown thus: millimetres (feet-inches)

Les dimensions sont indiquées comme suit:

millimètres (feet-inches)



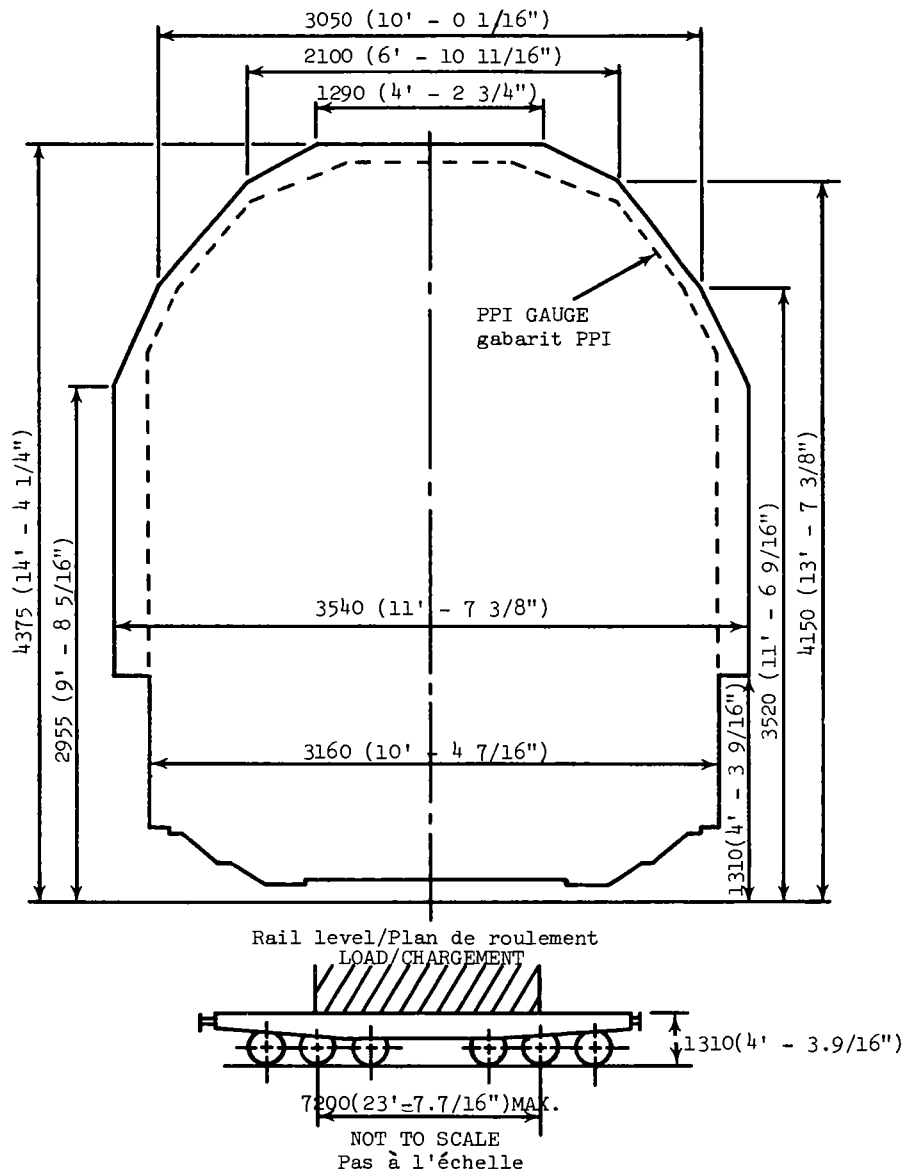
Rail level/Plan de roulement

B-1(DofA/MdeA) - 1
OTAN NON CLASSIFIE

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NATO UNCLASSIFIEDAPPENDIX 2 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 2 A L'ANNEXE B
(MdeA) AU STANAG 2805-ETZ GAUGE/GABARIT "TZ"

Dimensions shown thus: millimetres (feet-inches)
 Les dimensions sont indiquées comme suit:
 millimètres (feet-inches)



B-2(DofA/MdeA) - 1
OTAN NON CLASSIFIE

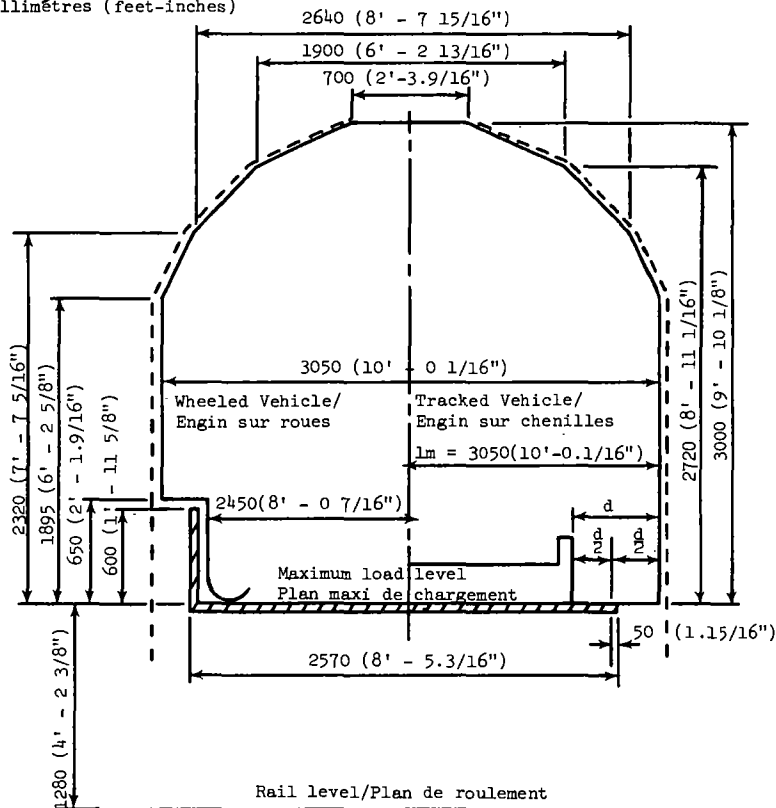
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APPENDIX 3 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 3 A L'ANNEXE B
(MdeA) AU STANAG 2805-EMANUFACTURE GAUGE FOR MILITARY VEHICLES/GABARIT DE
CONSTRUCTION POUR LES VEHICULES MILITAIRES
STANDARD/NORME A

Dimensions shown thus:
millimetres (feet-inches)
Les dimensions sont indiquées
comme suit:
millimètres (feet-inches)

Off centre correction./
Tolerances de centrage : + 40mm (1.9/16")



Rail level/Plan de roulement

——— Manufacture Gauge/Gabarit de construction

- - - P.P.I. Loading Gauge/Gabarit de chargement PPI
maximum length/longueur maxim:
10500mm (34' - 5 3/8")

Maximum STANAG classification: 12 (Approx)
Class STANAG maxi: 12 (approximativement)

- (1) For a tracked vehicle, the maximum width from the outside of the tracks (lm) must not exceed 3050mm (10' - 0.1/16") and must be compatible with $lm < 2570mm + d - 100mm$ (8' - 5.3/16" + d - 3 15/16")
Pour un engin chenillé la largeur maxi prise à l'extérieur des chenilles (lm) ne devra pas dépasser 3050 mm (10' - 0.1/16") et rester compatible avec la formule $lm < 2570mm + d - 100mm$ (8' - 5.3/16" + d - 3 15/16")

Any component outside this gauge must be capable of being detached or dismantled./

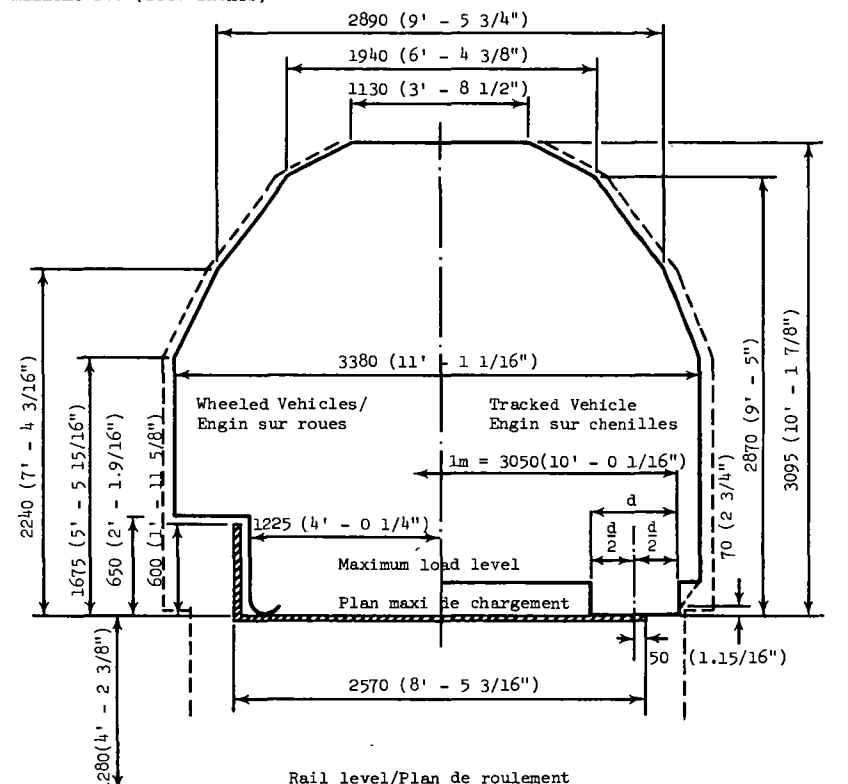
Tout élément dépassant le présent gabarit doit être rendu amovible ou démontable.

d: being the width of a track/
étant la largeur d'une chenille

B-3(DofA/MdeA) - 1
OTAN NON CLASSIFIE

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APPENDIX 4 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 4 A L'ANNEXE B
(MdeA) AU STANAG 2805-EMANUFACTURE GAUGE FOR MILITARY VEHICLES/GABARIT DE
CONSTRUCTION POUR LES VEHICULES MILITAIRES
STANDARD/NORME B1Dimensions shown thus:
millimetres (feet-inches)Off-centre correction/
Tolerances de centrage : + 40 mm (1.9/16")
- 40 mm (1.9/16")Les dimensions sont
indiquées comme suit:
millimètres (feet-inches)

— Manufacture Gauge/
Gabarit de construction
- - - TZ Loading Gauge/
Gabarit de chargement TZ

Maximum Length/Longueur Maximum:
10500 mm (34' x 5 3/8")
Maximum STANAG classification: 12 (approx)/
Class STANAG maxi: 12 (approximativement)

Any component outside this
gauge must be capable of being
detached or dismantled./

Tout élément dépassant le
présent gabarit doit être rendu
amovible ou démontable.

- (1) For a tracked vehicle the maximum width from the
outside of the tracks (lm) must not exceed 3050mm
(10' - 0.1/16") and must be compatible with
 $lm \leq 2570 \text{ mm} + d - 100 \text{ mm}$ (8' - 5.3/16" + d -
3 15/16").

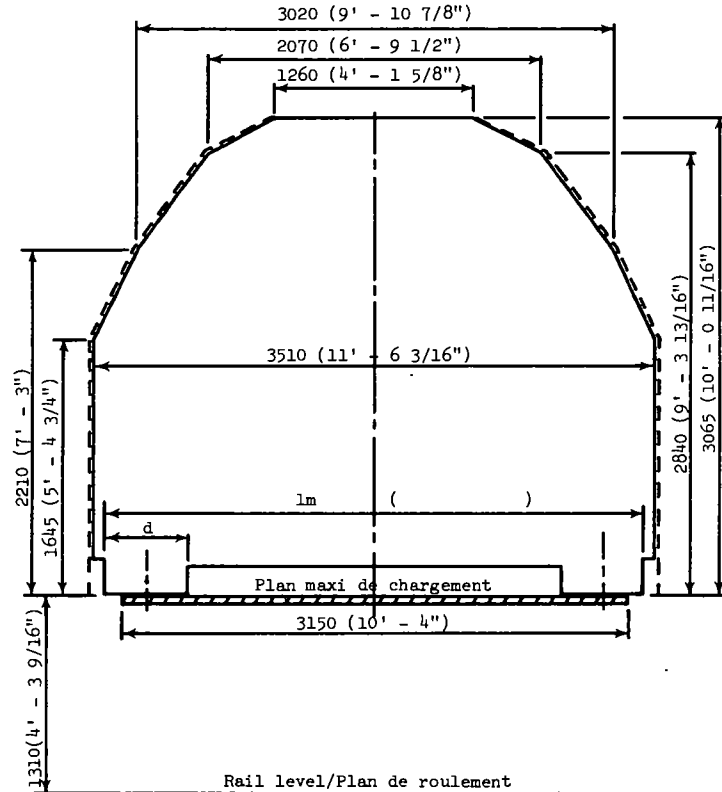
Pour un engin chenillé la largeur maxi prise à
l'extérieur des chenilles (lm) ne devra pas
dépasser 3050 mm (10' - 0.1/16") et rester
compatible avec la formule:
 $lm \leq 2570 \text{ mm} + d - 100 \text{ mm}$ (8' - 5 3/16" + d -
3 15/16").

d: being the width of a track/
étant la largeur d'une chenille

B-4(DofA/MdeA) - 1
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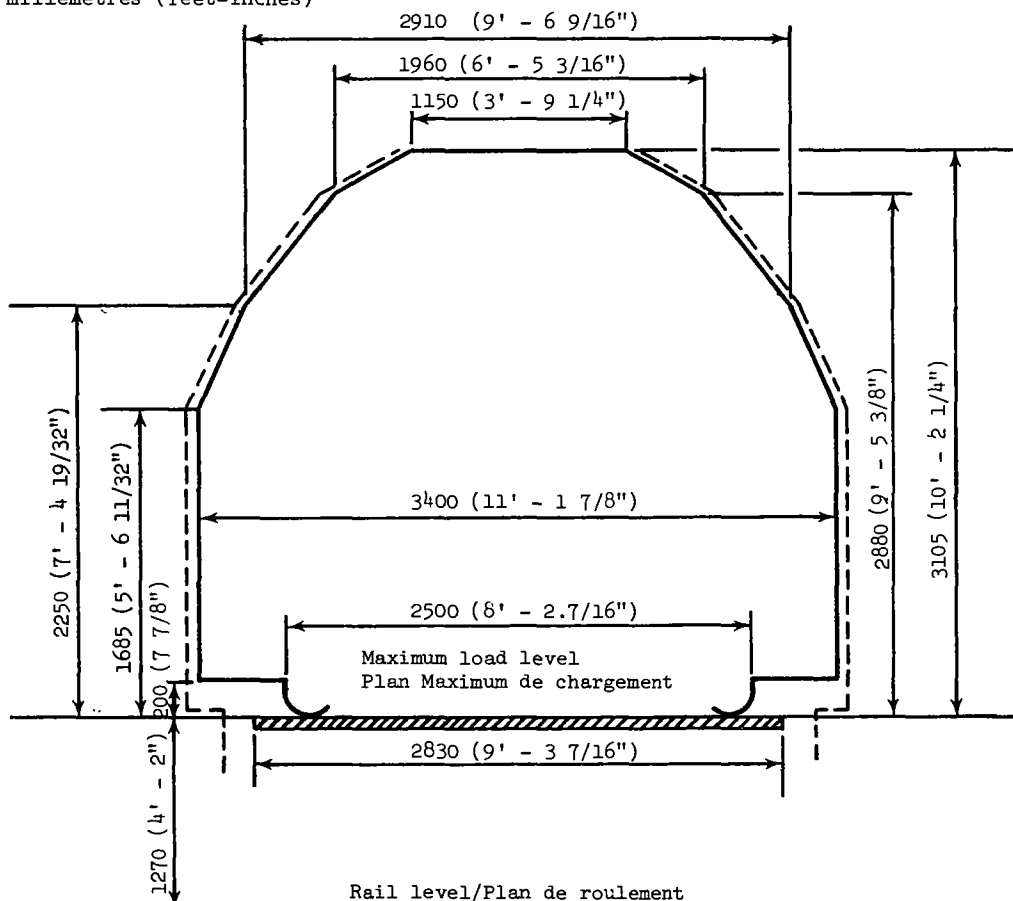
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APPENDIX 5 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 5 A L'ANNEXE B
(MdeA) AU STANAG 2805-EMANUFACTURE GAUGE FOR MILITARY VEHICLES/GABARIT DE
CONSTRUCTION POUR LES VEHICULES MILITAIRES
STANDARD/NORME B21Dimensions shown thus:
millimetres (feet-inches)Off-centre correction/ : + 15 mm (19/32")
Tolerances de centrage - 15 mm (19/32")Les dimensions sont
indiquées comme suit:
millimètres (feet-inches)— Manufacture Gauge/
Gabarit de constructionMaximum Length/Longueur Maximum: 7200 mm
(23' - 7 7/16")- - - TZ Loading Gauge/
Gabarit de chargement TZMaximum STANAG classification: 70 (Approx)/
Class STANAG maxi: 70 (approximativement)Any component outside this
gauge must be capable of being
detached or dismantled./lm: the maximum width from the outside of the
tracks, must not exceed 3510 mm (11' - 6 3/16")
and must be compatible with the formula:
 $lm < 3150 \text{ mm} + d - 100 \text{ mm} (10' - 4" + d - 3 15/16")$ Tout élément dépassant le
présent gabarit doit être
rendu amovible ou démontable.lm: la largeur maximum prise à l'extérieur des
chenilles ne devra dépasser 3,510 mm et rester
compatible avec la formule:
 $lm < 3150 \text{ mm} + d - 100 \text{ mm} (10' - 4" + d - 3 15/16")$ d: being the width of a track/étant la largeur
d'une chenilleB-5(DofA/MdeA) - 1
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APPENDIX 6 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 6 A L'ANNEXE B
(MdeA) AU STANAG 2805-EMANUFACTURE GAUGE FOR MILITARY VEHICLES/GABARIT DE
CONSTRUCTION POUR LES VEHICULES MILITAIRES
STANDARD/NORME B22Dimensions shown thus:
millimetres (feet-inches)Off-centre correction/
Tolerances de centrage : + 40 mm (1.9/16")
- 40 mm (1.9/16")Les dimensions sont indiquées comme suit:
millimètres (feet-inches)Any component outside this
gauge must be capable of being
detached or dismantled./Tout élément dépassant le
présent gabarit doit être rendu
amovible ou démontable

— Manufacture Gauge/Gabarit de construction

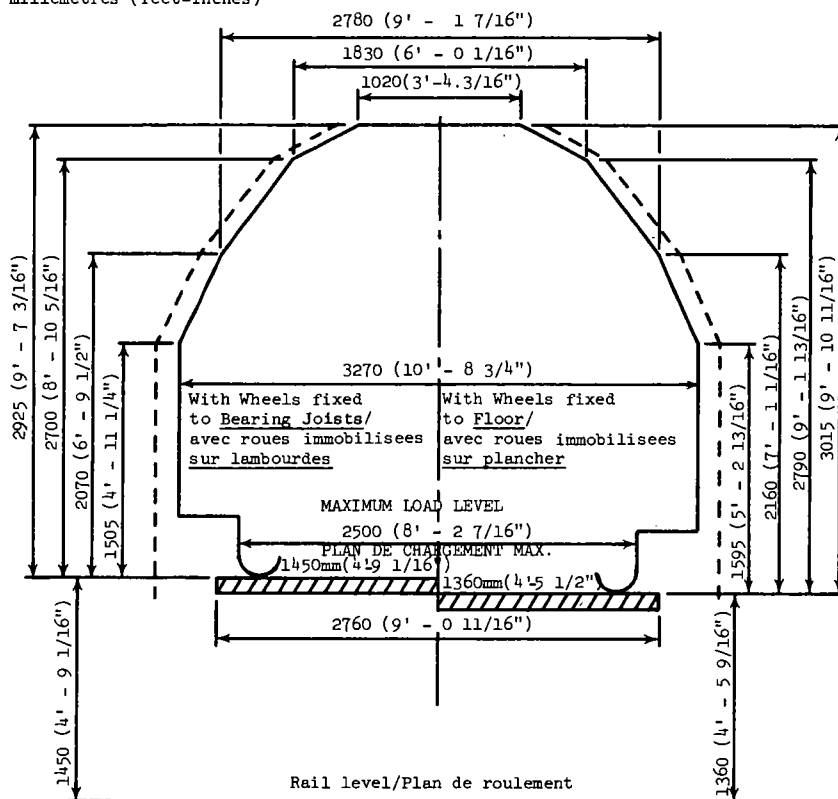
- - - TZ Loading Gauge/Gabarit de chargement TZ
Maximum Length/Longueur Maximum:
11000 mm (36' - 1.1/16")Maximum STANAG classification: 30 (approx)
Class STANAG maxi: 30 (approximativement)B-6(DofA/MdeA) - 1
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APPENDIX 7 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 7 A L'ANNEXE B
(MdeA) AU STANAG 2805-EMANUFACTURE GAUGE FOR MILITARY VEHICLES/GABARIT DE
CONSTRUCTION POUR LES VEHICULES MILITAIRES
STANDARD/NORME B23Dimensions shown thus:
millimetres (feet-inches)Off-centre correction/
Tolerances de centrage : + 40 mm (1.9/16")
- 40 mm (1.9/16")Les dimensions sont indiquées comme suit:
millimètres (feet-inches)

WHEELED VEHICLES/VEHICULE SUR ROUES



— Manufacture Gauge/Gabarit de construction

- - - TZ Loading Gauge/Gabarit de chargement TZ
maximum Length/Longueur Maximum 15000 mm
(49' - 2 1/2")Maximum STANAG classification: 30 (approx)
Class STANAG maxi: 30 (approximativement)

Any component outside this gauge must be capable of being detached or dismantled./

NOTE: The right hand diagram shows the maximum height permissible for the manufacture of a vehicle which would be loaded on the floor and not on bearing joists./

Tout élément dépassant le présent gabarit doit être rendu amovible ou démontable

NOTA: La 1/2 vue de droite indique les possibilités de hauteurs maxima de construction d'un véhicule dont les points d'appuis sur wagon seraient situés sur le plancher, en dehors des lambourdes.

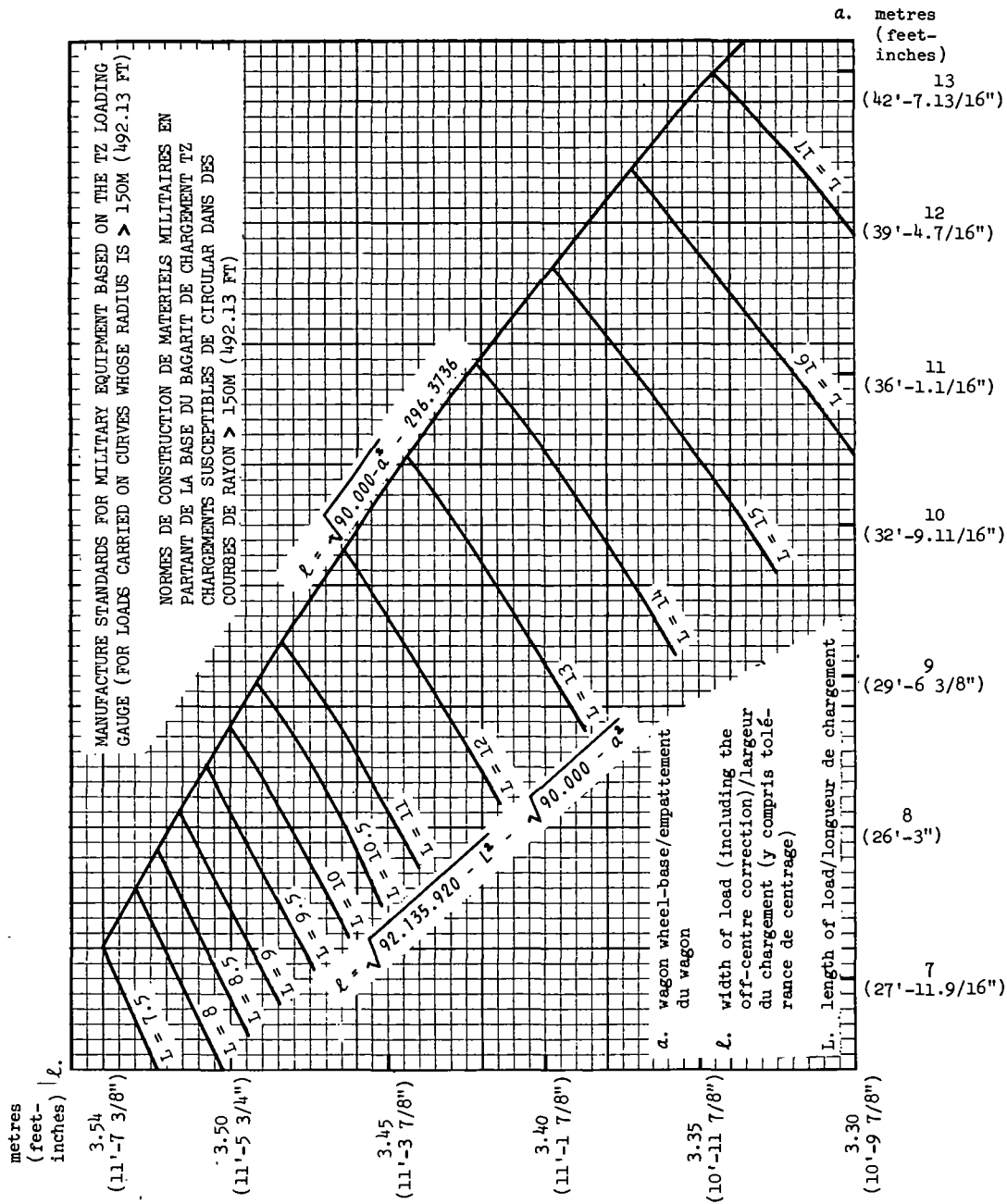
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APPENDIX 8 TO ANNEX B (DofA)
TO STANAG 2805-EAPPENDICE 8 A L'ANNEXE B
(MdeA) AU STANAG 2805-E

GRAPH/ABAUQUE

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OTAN NON CLASSIFIE

APPENDIX G

STANAG 2113

DESTRUCTION OF MILITARY TECHNICAL EQUIPMENT

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NATO UNCLASSIFIED STANAG 2113
Agreed English/French Texts.

DETAILS OF AGREEMENT (DofA) *DESTRUCTION OF MILITARY TECHNICAL EQUIPMENT*

Annex: A (DofA) Priorities for Destruction of Parts of Military Technical Equipment.

AGREEMENT

1. The NATO Army Forces agree:
 - a. That it is essential to destroy to the maximum degree possible military technical equipment, abandoned in wartime operations, to prevent its eventual repair and use by the enemy.
 - b. To follow the principles and priorities, set forth in this Agreement, in the destruction of their own equipment, when required.

PRINCIPLES AND PRIORITIES

2. *Detailed Methods.* Detailed methods of destroying individual items of equipment are to be included in the applicable technical publications, user handbooks and drill manuals.
3. *Means of Destruction.* Nations are to provide for the means of destruction for their own equipment.
4. *Degree of Damage.*
 - a. *General.* Methods of destruction should achieve such damage to equipment and essential spare parts that it will not be possible to restore the equipment to a usable condition in the combat zone either by repair or cannibalization.
 - b. *Classified Equipment.* Classified equipment must be destroyed in such degree as to prevent duplication by, or revealing means of operation or function, whenever possible, to the enemy.
 - c. *Associated Classified Documents.* Any classified documents, notes, instructions, or other written material pertaining to function, operation, maintenance, or employment, including drawings or parts lists, must be destroyed in a manner to render them useless to the enemy.
5. *Priorities for Destruction.*
 - a. Priority must always be given to the destruction of classified equipment and associated documents.

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- b. When lack of time and/or stores prevents complete destruction of equipment, priority is to be given to the destruction of essential parts, and the same parts are to be destroyed on all like equipment.
- c. A guide to priorities for destruction of parts for various groups of equipment is contained in Annex A (DofA) to this STANAG.
- 6. *Equipment Installed in Vehicles.* Equipment installed in vehicles should be destroyed in accordance with the priorities for the equipment itself, taking into account the relative importance of the installed equipment and the vehicle itself.
- 7. *Spare Parts.* The same priority, for destruction of component parts of a major item necessary to render that item inoperable, must be given to the destruction of similar components in spare parts storage areas.
- 8. *Cryptographic Equipment and Material.* The detailed destruction procedure to be followed in order to ensure the rapid and effective destruction of all types of cryptographic equipment and material is to be specified in instructions issued by the appropriate communication security authority.
- 9. *Authorization.* The authority for ordering the destruction of equipment is to be vested in the divisional and higher commanders who may delegate authority to subordinate commanders when the situation requires.
- 10. *Reporting.* The reporting of the destruction of equipment is to be done through command channels.

IMPLEMENTATION OF THE AGREEMENT

- 11. This STANAG will be considered to have been implemented when the priorities indicated therein have been incorporated in national documents detailing the method required for destroying the equipment concerned.

*ANNEX A (DofA) TO
STANAG 2113*

*PRIORITIES FOR DESTRUCTION OF PARTS OF MILITARY
TECHNICAL EQUIPMENT*

<i>EQUIPMENT</i>	<i>PRIORITY</i>	<i>PARTS</i>
1. <i>VEHICLES (INCLUDING TANKS AND ENGINEER EQUIPMENT)</i>	1	Carburetor/fuel pump/injector/distributor.
	2	Engine block and cooling system.
	3	Tires/tracks and suspensions.
	4	Mechanical or hydraulic systems (where applicable).
	5	Differentials.
	6	Frame.
2. <i>GUNS</i>	1	Breech, breech mechanism, and spares.

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<i>EQUIPMENT</i>	<i>PRIORITY</i>	<i>PARTS</i>
	2	Recoil mechanism.
	3	Tube.
	4	Sighting and fire control equipment (Priority 1 for Anti-Aircraft guns).
3. <i>SMALL ARMS</i>	5	Carriage and tires.
	1	Breech mechanism.
	2	Barrel.
	3	Sighting equipment (including Infra-red).
	4	Mounts.
4. <i>OPTICAL EQUIPMENT</i>	1	Optical parts.
	2	Mechanical components.
5. <i>RADIO</i>	1	Transmitter (oscillators and frequency generators).
	2	Receiver.
	3	Remote control units or switchboards (exchanges) and operating terminals.
	4	Power supply and/or generator set.
	5	Antennae.
	6	Tuning heads.
6. <i>RADAR AND OTHER ELECTRONIC EQUIPMENT</i>	1	Frequency determining components, records, operating instructions, which are subject to security regulations, and identification material (Identification Friend or Foe (IFF)).
	2	Antennae and associated components such as radiators, reflectors and optics.
	3	Transmission lines and waveguides.
	4	Transmitter high voltage components.
	5	Control consoles, displays, plotting boards.
	6	Cable systems.
	7	Automatic devices.
	8	Other control panels and generators.
	9	Carriage and tires.

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<i>EQUIPMENT</i>	<i>PRIORITY</i>	<i>PARTS</i>
7. <i>GUIDED MISSILE SYSTEMS</i>	1	Battery control centers.
	2	Missile guidance equipment (including homing systems).
	3	Launchers including control circuits.
	4	Missiles.
	5	Measuring and test equipment.
	6	Generators and cable systems.
8. <i>AIRCRAFT AND SURVEILLANCE DRONES</i>	1	Identification (IFF) equipment, other classified equipment, publications and documents pertaining thereto, and other materiel as defined by the national government concerned.
	2	Installed armament. (Use subpriorities for Group 2, Guns, or Group 3, Small Arms, as appropriate.)
	3	Engine Assembly. (Priorities for destruction of magnetos, carburetors, compressors, turbines and other engine sub-assemblies to be determined by national governments, depending on type of aircraft involved and time available for destruction.)
	4	Airframe/control surfaces/undercarriage. (Priorities for destruction of propellers, hub-rotor blades, gear boxes, drive shaft, transmissions, and other sub-assemblies (not already destroyed in priority 3) to be determined by national governments, depending on type of aircraft involved and time available for destruction.)

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<i>EQUIPMENT</i>	<i>PRIORITY</i>	<i>PARTS</i>
9. <i>ROCKETS</i>	5	Instruments, radios, and electronic equipment (not included in priority 1).
	6	Electrical, fuel, and hydraulic systems.
	1	Launcher.
	2	Rocket.
	3	Sights and fire control equipment.

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APPENDIX H
STANAG 2158
IDENTIFICATION OF MILITARY TRAINS

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STANAG 2158
(Edition No. 2)

Agreed English/French Texts.

DETAILS OF AGREEMENT (DofA)
IDENTIFICATION OF MILITARY TRAINS

AGREEMENT

1. The NATO Armed Forces have agreed to adopt the international identification code defined below for the identification of military trains.

BACKGROUND

2. a. A different procedure is used by each NATO Nation for the identification of military trains moving within its territory.
 - b. A national technical code number is used by each civilian railway organization for each individual train. This number, although primarily designed to keep a record of trains, may, however, give some indication as to the train's country of origin. This number is changed when frontiers are crossed and for various reasons it is impossible to contemplate retaining it beyond the frontier of the country of origin.
 - c. Some countries have though it necessary, for the benefit of their military authorities, to add a number to the technical code number, indicating thereby the nature of the contents of the train (troops or supplies). This additional number has so far been specially reserved for the use of the military authorities within the nation in question.
3. It was therefore essential that a standardized procedure be defined and that a code number be devised for the use of military authorities, (allied or national), which would remain unchanged throughout the journey across various frontiers and would cause no inconvenience to railway organizations (which would continue to use their technical numbers).

REQUIREMENTS

4. a. The code number, known, as the 'International Identification Code for Use on Military Trains' must show in particular:
 - (1) Movement execution priority, for which it has been agreed to adopt three classes, priority number one being the highest and being assigned in exceptional cases only.

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- (2) Country of origin.
 - (3) Date of departure.
 - (4) National identification code number; in order to ensure identification of a given train among other trains to which the above information might also apply (as in the case of several trains departing on the same day), a national identification code number (1) should be included at a given position, in the international code.
 - (5) Country of destination.
- b. Because of the complexity of the problem, this procedure will be used only for the identification of complete military trains as opposed to individual trucks or units. If a train is broken up on the final stage of its journey, only its biggest section may, if appropriate, retain the original number.
 - c. In the planning stage of initial movements the priority and the date of departure will be temporarily replaced in the International Identification Code Number by 0 (zero) and 00 (two zeros) respectively. If the priority is unknown, the index 0 will be used and the movement will take place at the lowest priority. The true date of departure will be given by the movements control agency as soon as it is known.

DEFINITION OF THE INTERNATIONAL IDENTIFICATION CODE FOR USE ON MILITARY TRAINS

5. The code will comprise a series of figures, letters or symbols, arranged as follows:

- a. One figure to indicate the movement execution priority.
- b. Two letters to indicate the country of origin (letters indicating the nationality as in STANAG 1059).
- c. Two figures to indicate the day of departure (in the current month).
- d. The national identification code number (1) as assigned by the country of origin.
- e. Two letters to indicate the country of destination.

6. For example:

2 - FR = 07-436239 = NL

identifies a military train as follows:

- a. Movement execution priority is 2.
- b. The country of origin is FRANCE.
- c. The date of departure is 7th of the current month.
- d. The national identification code number (1) assigned by FRANCE is 436239.
- e. The train contains items for shipment to the NETHERLANDS.

NOTE (1) This number may be either the national technical code number assigned by the railway organization in the country of origin or any other number assigned by the military authorities of that country and possibly providing information as to the nature of the load carried.

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IMPLEMENTATION OF THE AGREEMENT

7. The STANAG will be considered to have been implemented when the necessary orders/instructions putting the procedures detailed in the Agreement into effect have been issued to the forces concerned.

NOTE (1) This number may be either the national technical code number assigned by the railway organization in the country of origin or any other number assigned by the military authorities of that country and possibly providing information as to the nature of the load carried.

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